EQUINE

JOINT INJECTION AND REGIONAL ANESTHESIA

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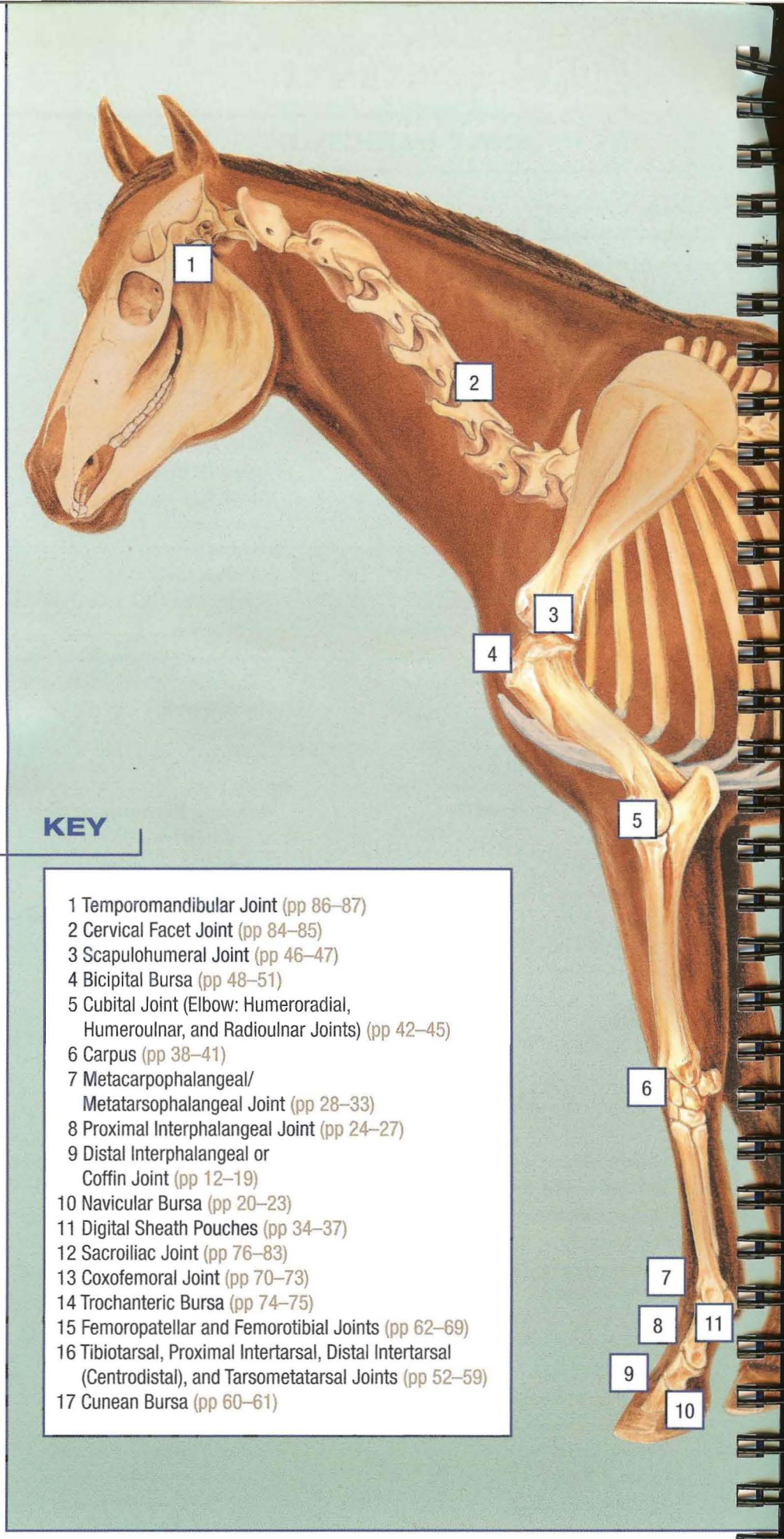

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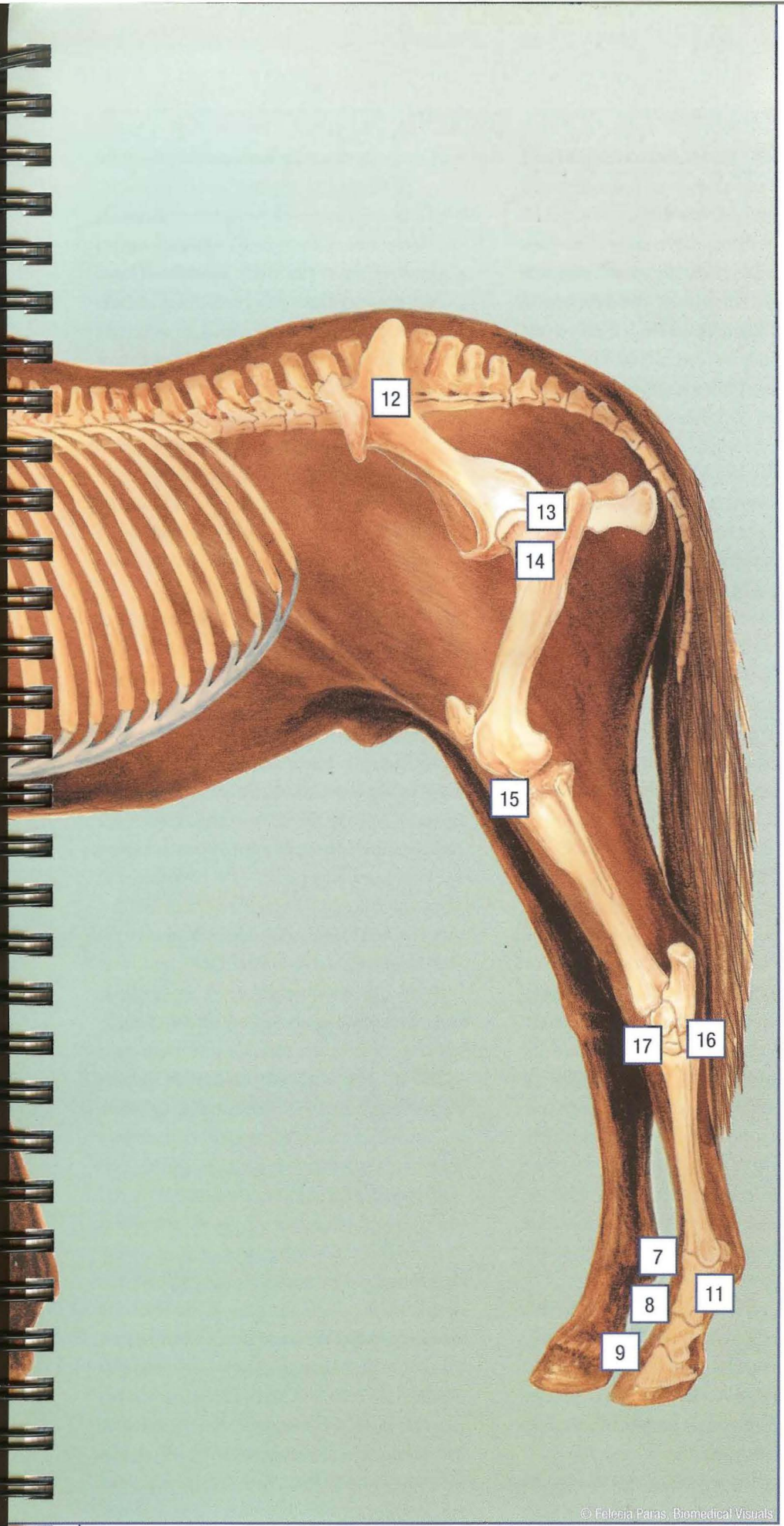


PART 1: JOINT INJECTION

INTRODUCTION AND USES

Arthrocentesis, a procedure used to administer drugs or collect synovial fluid, is a valuable technique for localizing pain during a lameness examination and for treating horses with joint disease. Improvements in the efficacy of intraarticularly administered medications and in surgical techniques used to treat horses with joint disease have placed increased importance on intraarticular analgesia to precisely localize the site of pain during lameness examinations. Although many clinicians may be reluctant to perform arthrocentesis because they fear introducing sepsis or causing injury, the procedure is rarely associated with complications when performed properly.

Using arthrocentesis to localize the site of lameness involves relatively little expense, and the results are usually straightforward and easily interpreted. However, performing arthrocentesis requires a thorough working knowledge of joint anatomy, an appreciation of aseptic technique, and skill in restraining horses.

PRACTICAL APPLICATIONS OF ARTHROCENTESIS

Some practical applications of arthrocentesis in horses are to:

- Administer medication, such as sodium hyaluronate, a corticosteroid, an antimicrobial drug, or polysulfated glycosaminoglycan.
- Verify or negate intraarticular pain as the cause of lameness. If pain arises from a joint, intraarticular anesthesia is more precise than regional anesthesia in localizing the source of pain. There are at least two situations in which a positive or negative response to intaarticular anesthesia does not verify or negate intraarticular pain as a cause of lameness:
  - — Intraarticular anesthesia may not resolve lameness if disease of subchondral bone contributes to joint pain because subchondral bone is innervated by nerve branches that enter the bone through its nutrient foramen.[1,2]
  - — Intraarticular anesthesia of the coffin joint anesthetizes the palmar digital nerves as they course adjacent to the joint capsule. Because anesthesia of the coffin joint causes anesthesia of the palmar digital nerves, a positive response to a coffin joint block does not necessarily indicate that the joint is the source of pain.[3]
- Collect synovial fluid for examination. Analysis of synovial fluid ranges from gross inspection of the fluid to sophisticated examinations, including cultures to identify pathogens, physical or chemical tests, and microscopic examination by a light or electron microscope.[4,5]
- Administer a radiographic contrast medium or sterile isotonic electrolyte solution to determine, by radiographic or visual examination, whether a synovial structure communicates with a nearby wound.
- Provide both entry and exit portals in joints requiring lavage.[6–9]

Arthrocentesis is mostly commonly used to administer local anesthetic solution into the joint. Mepivacaine hydrochloride is preferred by most clinicians because, compared with lidocaine hydrochloride, it is relatively nonirritating to tissue and induces relatively long-acting intraarticular anesthesia (about 90 minutes). A long duration of anesthesia is advantageous when multiple sites of lameness are being investigated.

INTRAARTICULAR VERSUS REGIONAL ANESTHESIA

Intraarticular anesthesia is often more precise and useful than regional anesthesia in establishing diagnostic information for several reasons.

The location and distribution of sensory nerves in horses vary considerably; therefore, the clinician cannot be certain, after administering regional anesthesia, that a specific area has been anesthetized (i.e., blocked).

Testing the efficacy of a regional nerve block by testing for lack of skin sensation with a pointed instrument, such as a toothpick, ballpoint pen, or car key, is of dubious worth because it verifies only that the skin has been desensitized. Therefore, the clinician cannot be certain that a joint has been blocked after administering regional anesthesia. However, direct instillation of a local anesthetic solution into a joint leaves little or no doubt that intraarticular structures are anesthetized.

A regional nerve block may not adequately localize the source of pain responsible for lameness. In addition to desensitizing articular structures, a successful regional nerve block desensitizes a multitude of extraarticular structures,

such as ligaments, tendons, tendon sheaths, subcutaneous tissue, and extraarticular bone.

Intraarticular anesthesia is more useful than regional anesthesia when a clinician is attempting to establish the significance of multiple clinical or radiographic findings on a horse's limb. An excellent and common example is a horse that has radiographic evidence not only of disease of the fetlock joint but also of extraarticular disease of the proximal sesamoid bones and proliferative and degenerative changes of the pastern joint. The use of regional anesthesia in such a horse does not allow pain to be selectively localized to allow accurate assessment of each lesion's contribution to lameness. Without precise assessment of each lesion's contribution to lameness, selecting an ideal therapy and establishing an accurate prognosis are difficult.

Regional nerve blocks occasionally create temporary gait abnormalities, which can cause injury by interfering with proprioception. For example, blocking the deep peroneal nerve in the gaskin region or the common peroneal nerve more proximally can cause a horse to stumble because it lacks proprioception in the blocked limb.

If the local anesthetic solution contains epinephrine, extensive subcutaneous administration can cause subcutaneous inflammation, swelling, and even skin necrosis.

Many horses resent a regional block more than a joint block because a regional block often requires multiple injections.

A regional nerve block does not allow the examiner the opportunity to examine synovial fluid of a joint suspected to be the source of lameness. Examination of synovial fluid, both grossly and microscopically, may provide "one more piece" to the diagnostic puzzle.

Even though instillation of local anesthetic solution into a joint or bursa is more precise than regional anesthesia in pinpointing the site of pain, diffusion of local anesthetic solution from some joints or bursae into surrounding joints or adjacent nerves may make interpretation of the effects of intrasynovial administration of local anesthetic solution difficult. For instance, local anesthetic solution injected into the tarsometatarsal joint may result in perineural anesthesia of the dorsal metatarsal and plantar metatarsal nerves.[10] Because the plantar metatarsal nerves innervate the proximal portion of the suspensory ligament, resolution of lameness after a tarsometatarsal joint block may be erroneously interpreted as resolving pain within that joint even though pain from the proximal portion of the suspensory ligament is the cause of lameness.[10] Anesthesia of the coffin joint also anesthetizes the navicular apparatus,[11] the toe region of the sole, and, with sufficient volume, the heel region of the sole.[12,13] Anesthesia of the navicular bursa also anesthetizes the toe region of the sole.[14]

PREPARATION OF THE SITE

Removing hair with a razor or clippers before inserting a sharp hypodermic needle into a joint increases the risk of contaminating the joint with hair.[15] The presence of hair does not appear to inhibit the ability of an antiseptic soap to effectively reduce bacteria to an acceptable concentration for arthrocentesis.[16] The site of arthrocentesis should be thoroughly scrubbed with an antiseptic soap, such as polyhydroxydine solution, povidone–iodine, or chlorhexidine, for a total contact time of 7 minutes or longer. The last application of antiseptic soap should not be rinsed until the clinician is ready to insert the needle. At that time, the area should be liberally sprayed or wiped with 70% isopropyl alcohol until it is free of soap. Excess alcohol should be wiped away with a sterile gauze sponge or a gloved hand. Removing the stylet from a spinal needle decreases the risk of contaminating the joint with hair because it avoids entrapment of hair between the needle and the stylet.[15] If a relatively large-bore (e.g., 18-gauge) needle is to be used, subcutaneous injection of a small amount of local anesthetic solution using a small-bore (e.g., 25-gauge) needle may help diminish resentment by the horse when the large-bore needle is inserted.

MANAGEMENT OF THE HORSE

Methods of restraining the horse for arthrocentesis vary with the anticipated and actual behavior of the horse, the availability of experienced help, the environment, and the specific joint to be entered. The clinician should anticipate problems rather than assume that the procedure will be trouble free. The wishes of the owner or trainer may influence the type of physical restraint used.

An experienced assistant should control the horse by using a lead shank and nose twitch.

Usually, a needle-shy horse is identified as such because of its well-established history of such behavior. A truly dangerous horse poses a risk to both itself and the clinician. By changing the environment, the veterinarian can usually provide conditions suitable for work on a dangerous horse. A slow, quiet approach is best. Some clinicians prefer restraining a fractious horse in a stock to minimize personal risk, but a stock can be a danger to the horse.

If application of a nose twitch or lip chain does not provide sufficient restraint for joint injection, xylazine hydrochloride or detomidine hydrochloride can be administered intravenously to most horses without decreasing the degree of lameness.[17,18] Xylazine may be more useful for restraint than detomidine because of its shorter duration of action. A low dose of intravenously administered acepromazine maleate, such as 5 mg to a horse of average size (0.01 mg/kg), can also be useful for restraining a fractious horse during diagnostic analgesia without interfering with interpretation of the lameness examination.[19,20] The degree to which sedation or tranquilization may interfere with assessment of gait, however, may depend on the severity of lameness and the skill of the clinician performing the examination. Because of the uncertainty of the effect of sedation or tranquilization on gait, a sedative or tranquilizer is best avoided, if possible. When the horse must be sedated to administer local anesthetic solution, antagonizing the sedative effects of an α_2-agonist, such as xylazine, with yohimbine hydrochloride or tolazoline hydrochloride may make interpretation of diagnostic analgesia easier.[17,21]

Performing arthrocentesis in a poor environment can potentially complicate the procedure and increase the risk of error or injury. The environment in which the procedure is to be performed should be inspected carefully. A dusty area increases the likelihood of introducing an infection; a crowded area, filled with such distractions as people, equipment, extraneous noise, and other horses, increases the likelihood that an accident will occur.

GENERAL TECHNIQUE

The single most important factor for successful placement of a needle within a joint is an accurate appreciation of relevant anatomy. If the clinician infrequently performs arthrocentesis of a particular joint, the anatomy of that joint should be reviewed. The clinician should strive for performance that is quick and successful at the outset because multiple attempts at arthrocentesis increase the likelihood of failure as well as injury to both the horse and the clinician. Adequate preparation helps prevent or minimize most problems.

The joint and the site of entry determine the position of the clinician relative to the horse and whether the injection is performed with the limb bearing weight or held. The bore and length of the needle depend on the particular joint being injected and the size of the horse. Handling the shaft of the needle and palpating the site of injection may be necessary to ensure proper insertion; therefore, sterile gloves should be worn to reduce the risk of bacterial contamination.

To begin the procedure, the joint and surrounding structures within the scrubbed area are palpated to identify the landmarks. The needle is inserted with a quick thrust through the skin. The needle should be inserted without the syringe attached. A syringe can act as a lever, and sudden movement by the horse may cause the needle to damage tissue. To avoid broken needles, only disposable needles that are reasonably flexible should be used. A needle longer than the length required to enter the joint is more likely to bend than break when stress is applied.

The depth of needle penetration varies with the joint. To penetrate the carpal, tibiotarsal, and fetlock joints, the needle is inserted relatively superficially, but to penetrate the coffin, pastern, and elbow joints and the medial and lateral compartments of the femorotibial joint, the needle may need to be inserted 1 to 1.5 inches (2.5 to 3.8 cm) depending on the size of the horse and the approach used. Because clinicians do not always enter the joint space with the initial thrust, the needle sometimes must be redirected; if possible, it should be redirected without being withdrawn through the skin. To practice the best possible technique and reduce the risk of contaminating a joint, a new needle should be used for the next attempt at centesis if the needle cannot be redirected without withdrawing it through the skin.[15] Experience helps the clinician identify underlying tissue by its texture as the needle penetrates.

The most accurate indication of successful arthrocentesis is the presence of synovial fluid

exiting the needle. However, the clinician can place a needle correctly within a joint without being able to see or aspirate synovial fluid for such reasons as:

- Some joints normally contain a very small volume of synovial fluid (e.g., distal joints of the tarsus).
- The needle opening may be against synovial villi or cartilage.
- Aspiration may have pulled villi into the needle opening.
- A chronically inflamed joint may contain a less-than-normal amount of synovial fluid.
- Hypertrophied villi and joint capsular thickening caused by chronic inflammation may have reduced the volume of the damaged joint.
- The needle may have become plugged with tissue.

After the needle is situated correctly within the joint, synovial fluid should be allowed to drip out of the hub of the needle or aspirated into a separate syringe to clear tissue and hair debris from the lumen of the needle before injection to decrease the risk of joint contamination.[15] In some cases, the degree of resistance to pressure on the syringe plunger during injection may be the only way to determine whether the joint was entered. If the needle is placed correctly, resistance to injection is slight; however, for some joints, such as the shoulder or stifle joint, lack of resistance to pressure on the plunger of the syringe is not a good indication that the joint has been entered. Syringes that lock onto the needle hub (e.g., Luer Lock syringes) should be avoided because sudden motion may require that the syringe be detached quickly from the needle to prevent the needle from being pulled out or the syringe from acting as a lever, which may either result in injury to the horse or break the shaft of the needle.

To avoid the complication of joint infection, a needle should not be inserted into a joint through inflamed tissue. Inflammation may be the result of a recent wound, subcutaneous infection, dermatitis, recent local cautery, or application of a counterirritant. Many joints can be entered using an alternative approach remote from the site of inflammation.

ONSET OF ANALGESIA

Lameness has been observed to resolve within 5 minutes after injecting mepivacaine into the middle carpal joint of horses that are lame because of pain associated with that joint.[22] Administration of local anesthetic solution into joints of the distal portion of the limb also usually results in analgesia within 5 minutes.[19] Onset of analgesia is delayed when local anesthetic solution is administered into joints larger than those of the distal portion of the limb. For instance, analgesia of the coxofemoral joint may not occur for 30 minutes after administration of local anesthetic solution.

INJECTION STRATEGIES

Specific, step-by-step details of the injection techniques for 18 joints and five bursae and tendon sheaths are discussed and illustrated in the pages that follow. For each joint or bursa, we have listed an approximate needle size. The amount of local anesthetic solution instilled into a joint is arbitrary, but we have stated a volume that can reasonably be injected. For many joints, several approaches for arthrocentesis are described. Being able to insert a needle into a joint at several sites is often necessary because a wound or infection in one area may necessitate that the joint be entered in another area. Sometimes an ingress and egress portal for lavage of the joint must be established. Also, we have assigned a degree of difficulty to each approach to the joint, bursa, or tendon sheath based on a scale of 1 to 3, with 1 indicating the lowest degree of difficulty.

COMPLICATIONS

Occasionally, a clinician experiences complications resulting from arthrocentesis, which must be resolved promptly. For instance, certain bacteria, primarily *Staphylococcus aureus*, can rapidly cause irreparable damage when introduced into a joint.

The two most common serious complications of arthrocentesis are a broken needle and postinjection reaction. Listed below are the immediate and follow-up steps the clinician should take when presented with one of these complications.

BROKEN NEEDLES

The likelihood of breaking a needle in a joint is low, and properly restraining the horse and using flexible, disposable needles can further

reduce the risk. Joints that are considered high risk in terms of broken needles—the coxofemoral, shoulder, and to some extent, the femoropatellar joint—should be entered using a spinal needle because these needles are particularly flexible and usually bend to accommodate stress, rather than break. If a needle does bend, it should be removed slowly, following the curve of its bend. Even though needles usually break at skin level, broken needles are typically difficult to retrieve. Unless a needle appears to be readily accessible, it is best extracted while the horse is anesthetized. General anesthesia allows for more careful exploration and manipulation. Radiographic examination of projections taken at multiple angles, ultrasonography, or fluoroscopy may help identify the exact location of the needle. Arthroscopic retrieval of the needle and assessment of the joint may be necessary.

After the needle has been retrieved, the joint must be considered contaminated and should be copiously lavaged with a sterile isotonic electrolyte solution. The degree of damage and the appearance of the internal environment of the joint determine the extent of aftercare.

POSTINJECTION REACTIONS

Horses that suffer from a postinjection reaction can be difficult to manage because distinguishing between a local drug reaction and early infection caused by contamination is often impossible. Early signs of either problem include heat, pain, swelling, and lameness. In either case, the interval between the injection and the onset of clinical signs may be similar and, therefore, cannot be used to determine whether the inflammation is caused by infection. In either case, analysis of synovial fluid reveals inflammation of the joint, but determining whether the inflammation is caused by sepsis is often not possible unless bacteria can be found during cytologic examination or cultured from synovial fluid.

It is prudent to assume that a painful joint is infected; therefore, the horse should be treated accordingly. Initial treatment is lavage of the joint with a copious amount of a sterile, isotonic electrolyte solution (Figure 1). This can often be accomplished, depending on the joint involved and the temperament of the horse, with the horse sedated rather than anesthetized. Lavage is performed as follows, regardless if the horse is sedated or anesthetized:

1. Prepare the skin over the joint for aseptic insertion of needles or catheters.
2. Use large-bore (i.e., 16-gauge or greater) needles or catheters for most joints.
3. If the procedure is performed with the horse standing, distend the joint with an appropriate sterile local anesthetic solution. Allow enough time for the anesthetic solution to anesthetize the joint.
4. With the first needle in position and the joint distended with a local anesthetic solution or sterile isotonic electrolyte solution, insert a second needle into the joint at another site. The joint should be lavaged with copious amounts of sterile isotonic electrolyte solution. Distend the joint maximally two to three times during the lavage.[7-9] Distension allows the cleansing solution to circulate into the deep crevices and folds of synovial tissue. If the procedure is performed with the horse anesthetized, lavaging the joint using an arthroscopic cannula may be beneficial because the joint can be visually examined and a large quantity of solution can be forced through the joint.
5. Administer an appropriate antimicrobial drug directly into the joint at the end of lavage.
6. Administer an appropriate antimicrobial drug systemically.
7. Perform regional perfusion of the affected region of the limb with an antimicrobial drug, if possible and appropriate.
8. Confine the horse and support the joint with a suitable bandage (if the area can be bandaged).

The decision to repeat joint lavage and the duration of antimicrobial therapy depend on:

- The clinical appearance of the joint and the horse's response to treatment.
- Isolation and identification of a causative agent.
- The wishes of the owner or trainer.

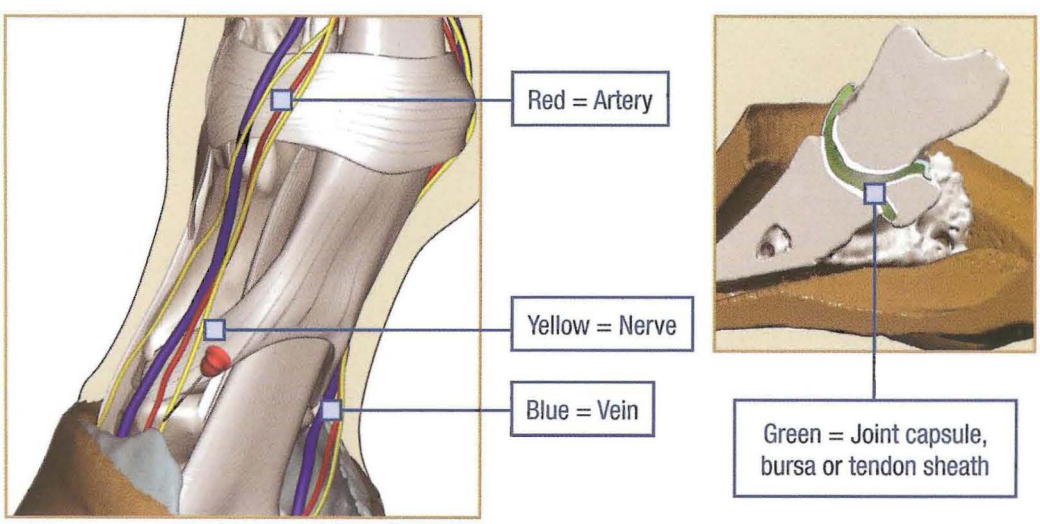
MEDICATION RULES

A possible third complication is related not to health problems but to medication rules for competition horses. Keep in mind that some medications are detectable; therefore, this could create a problem for the owner or trainer if the horse is tested.

Figure 1: This photograph illustrates flushing a sedated foal's infected right stifle using sterile isotonic electrolyte solution. Note the placement of large-bore needles, which permits an optimal lavage.

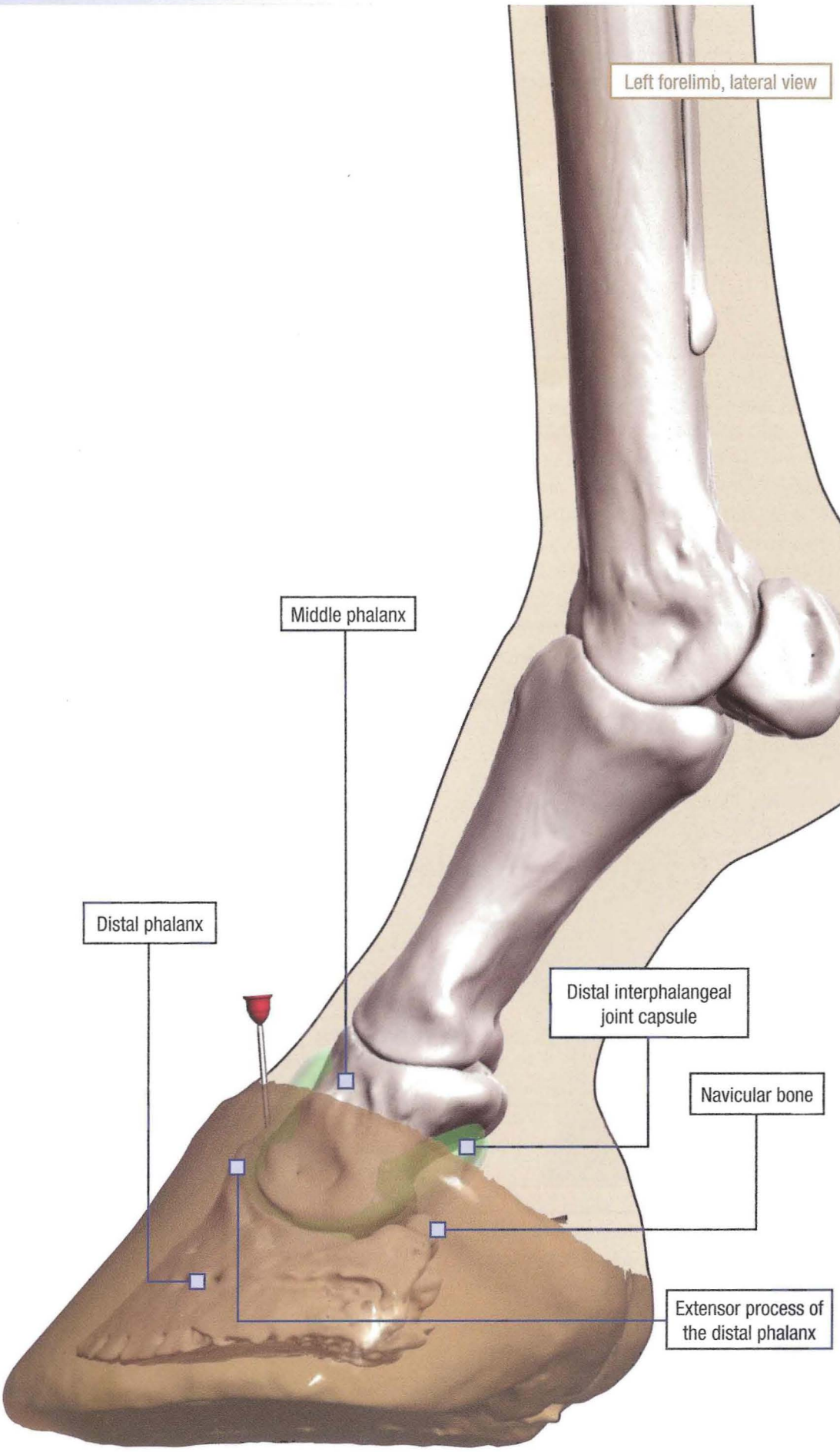
KEY TO ILLUSTRATIONS

Note: In the illustrations, all needles are depicted with red hubs for visibility and consistency. The actual gauge, size, and type of needle vary by procedure, joint to be entered, and nerve to be blocked.

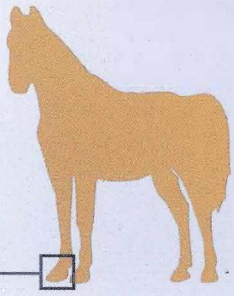


DISTAL INTERPHALANGEAL OR COFFIN JOINT

DORSAL PERPENDICULAR APPROACH



Needle: 1.5 in. (3.8 cm), 20 ga
Volume: 4 to 6 mL
Degree of difficulty: 2/3



The **distal interphalangeal** or **coffin joint** (P2–P3, coronopedal joint) is most easily entered with a needle using a dorsal approach, with the limb bearing weight. Consequently, the dorsal approach may be more dangerous than the lateral approach in which the foot is held.

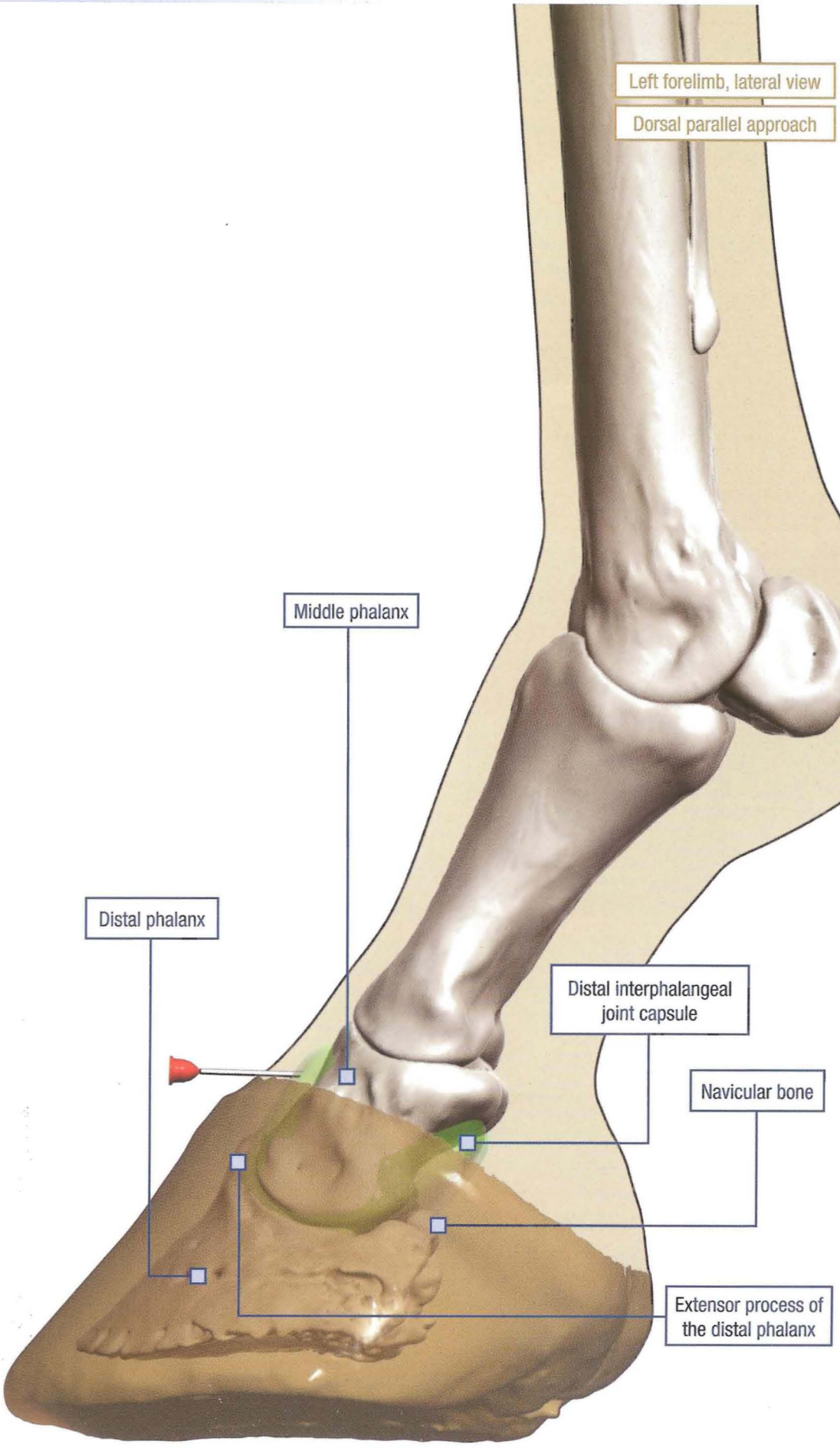
Insert the needle into the joint at the proximal edge of the coronet. For most horses, this point is approximately 0.25 to 0.5 inch (0.6 to 1.3 cm) above the edge of the hoof wall, approximately 0.75 inch (2 cm) lateral or medial to an imaginary line drawn vertically through the center of the phalanges. Direct the needle perpendicular to the weight-bearing surface of the foot. The size of the foot determines the depth of penetration, but generally this depth is about 1 to 1.5 inches (2.5 to 3.8 cm). The procedure can be performed with the foot held, but it is generally easier to accomplish with the limb bearing weight. Synovial fluid usually appears in the needle hub, but accuracy of needle placement can also be ascertained by ease of injection. After injection, the syringe should refill when pressure on the plunger is released.

Palpate the proximal edge of the coronet, approximately 0.75 inch (2 cm) lateral to the dorsal, longitudinal midline of the proximal interphalangeal joint. *Note: Needle is in the left forelimb.*

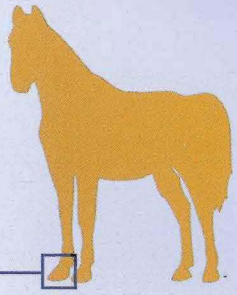
Insert the needle into the joint by directing the needle perpendicular to the weight-bearing surface of the foot, through the coronet, on or slightly medial or lateral to the dorsal, longitudinal midline of the pastern, to a depth of approximately 1 to 1.5 inches (2.5 to 3.8 cm). *Note: Needle is in the left forelimb.*

DISTAL INTERPHALANGEAL OR COFFIN JOINT

DORSAL PARALLEL OR INCLINED APPROACH



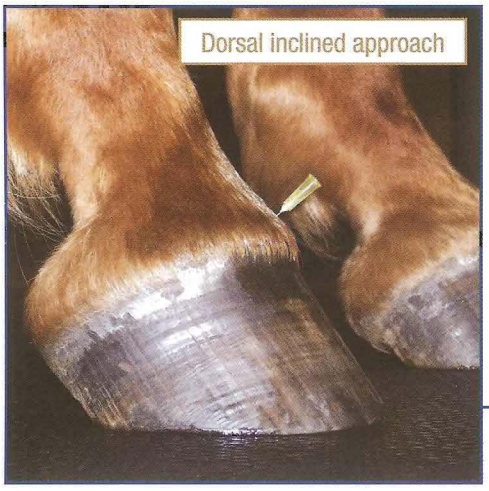
Needle: 1 in. (2.5 cm), 20 to 22 ga
Volume: 4 to 6 mL
Degree of difficulty: 1/3



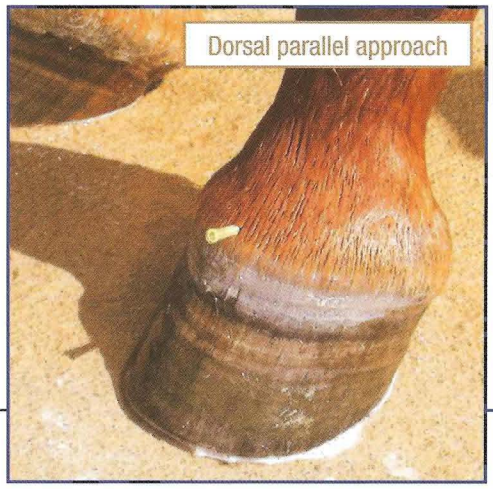
The dorsal parallel or inclined approach to the **distal interphalangeal** or **coffin joint** (P2–P3, coronopedal joint) is easier to perform accurately than the dorsal perpendicular approach or the lateral approach (see pages 12 and 13 and pages 18 and 19, respectively). The dorsal pouch of the coffin joint can be entered by inserting the needle through or immediately proximal to the coronary band, parallel to the weight-bearing surface of the foot; alternatively, the needle can be inserted slightly proximal to the coronary band, perpendicular to the slope of the pastern (inclined approach) on the dorsal midline. Insert the needle until the dorsal aspect of the middle phalanx is encountered. The depth of penetration is less than 0.5 inch (1.3 cm). The procedure is most easily performed with the limb bearing weight and consequently may be more dangerous than the lateral approach, in which the foot is held. Using a nose twitch increases the safety of the procedure. Synovial fluid usually appears in the needle hub, but accuracy of needle placement can also be determined by ease of injection and return of anesthetic solution into the syringe when pressure on the plunger is released.

Local anesthetic solution administered into the coffin joint desensitizes the coffin joint,[23] the navicular bursa,[11] the navicular bone,[18,24,25] the toe region of the sole,[12,13] and, for most horses, the digital portion of the deep digital flexor tendon.[26] When a large volume of local anesthetic solution (e.g., 10 mL or a volume sufficient to cause back-pressure on the syringe plunger) is administered, the heel region of the sole may also be desensitized.[13] We believe that administration of a large volume of local anesthetic solution into the coffin joint has the same effect as a palmar digital nerve block.

The most plausible explanation for analgesia of the navicular apparatus (i.e., the navicular bone and its associated ligaments) after local anesthetic solution is administered into the coffin joint is that the palmar digital nerves are desensitized where they lie in proximity to the palmar pouch of the coffin joint.[11,27] Anesthesia of the toe region of the sole and, often, the palmar aspect of the coronary band after intraarticular anesthesia of the coffin joint,[13] supports the theory that analgesia of the coffin joint causes desensitization of the palmar digital nerves. Another explanation is that a substance of low molecular weight, such as a local anesthetic solution, may diffuse from the coffin joint into the navicular bone and bursa.[28,29]



Insert the needle parallel to the weight-bearing surface of the foot or perpendicular to the slope of the pastern, through the coronary band, until the dorsal aspect of the middle phalanx is encountered. *Note: Needle is in the right forelimb.*

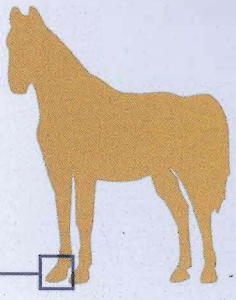


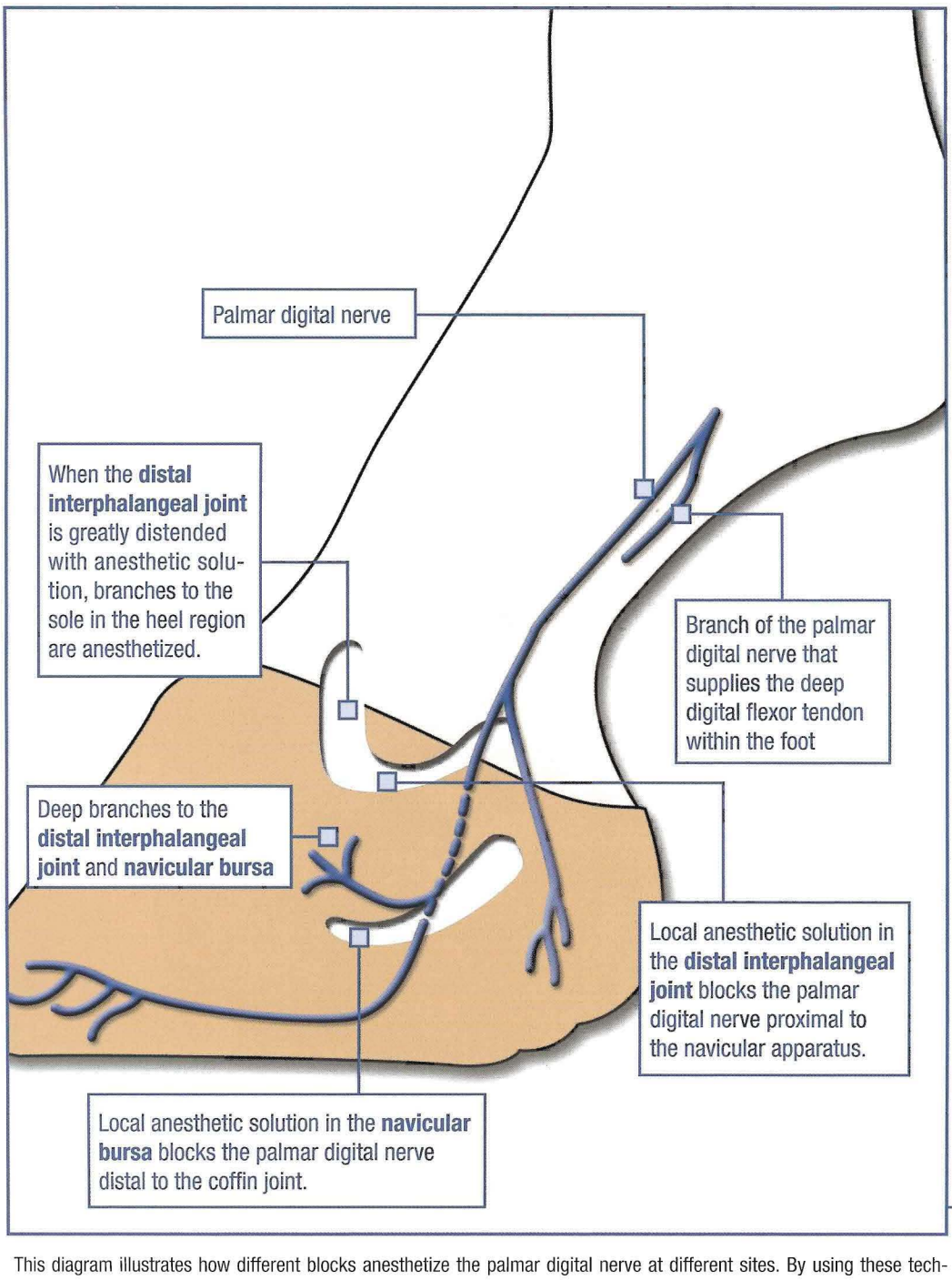
Insert the needle until it strikes the middle phalanx. *Note: Needle is in the left forelimb.*

DISTAL INTERPHALANGEAL OR COFFIN JOINT

CONTINUED

Needle: 1 in. (2.5 cm), 20 to 22 ga
Volume: 4 to 6 mL
Degree of difficulty: 1/3

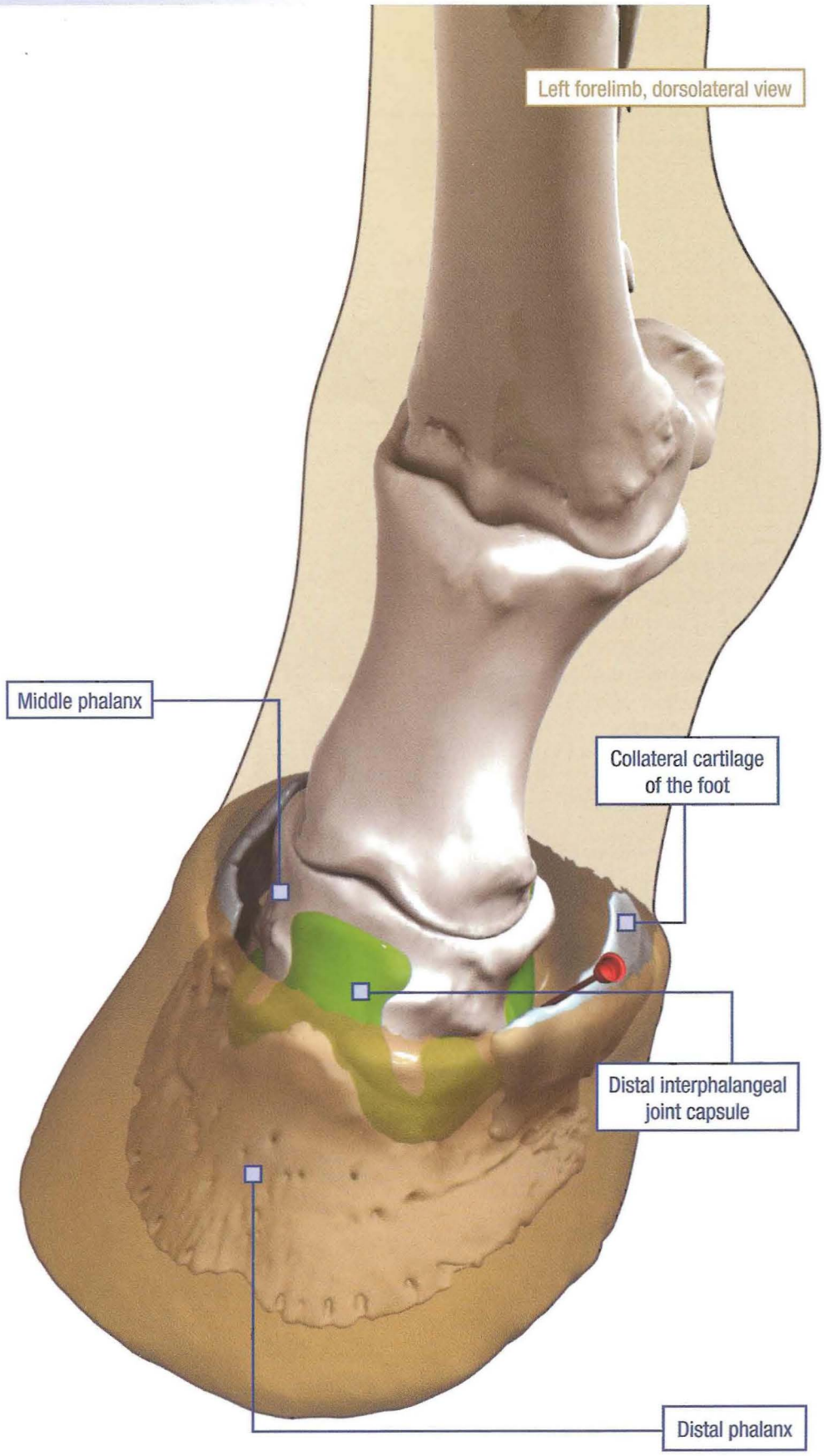




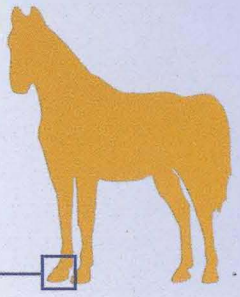
This diagram illustrates how different blocks anesthetize the palmar digital nerve at different sites. By using these techniques, pain can often be localized to a particular region within the foot.

DISTAL INTERPHALANGEAL OR COFFIN JOINT

LATERAL APPROACH



Needle: 1 in. (2.5 cm), 20 to 22 ga
Volume: 4 to 6 mL
Degree of difficulty: 1/3



The **distal interphalangeal** or **coffin joint** (P2–P3, coronopedal joint) can also be entered from the lateral aspect of the joint.[30] Insert a 1-inch (2.5-cm), 20- to 22-gauge needle through the skin, just above the palpable, proximal edge of the collateral cartilage of the foot, approximately midway between the dorsal and palmar/plantar aspects of the middle phalanx. Angle the needle distally toward the medial aspect of the weight-bearing surface of the foot. The procedure can be performed with the limb in either the weight-bearing or non–weight-bearing position. The depth of successful penetration is usually less than 1 inch (2.5 cm). We find this technique to be apparently less discomforting to the horse than the dorsal approaches.

Using the lateral approach to the coffin joint, the navicular bursa or digital tendon sheath can be entered inadvertently.[30] The likelihood of entering either of these two synovial structures increases if the needle is inserted palmar/plantar to the recommended site of insertion. Using a needle no longer than 1 inch (2.5 cm) may decrease the likelihood of entering the navicular bursa or digital tendon sheath.

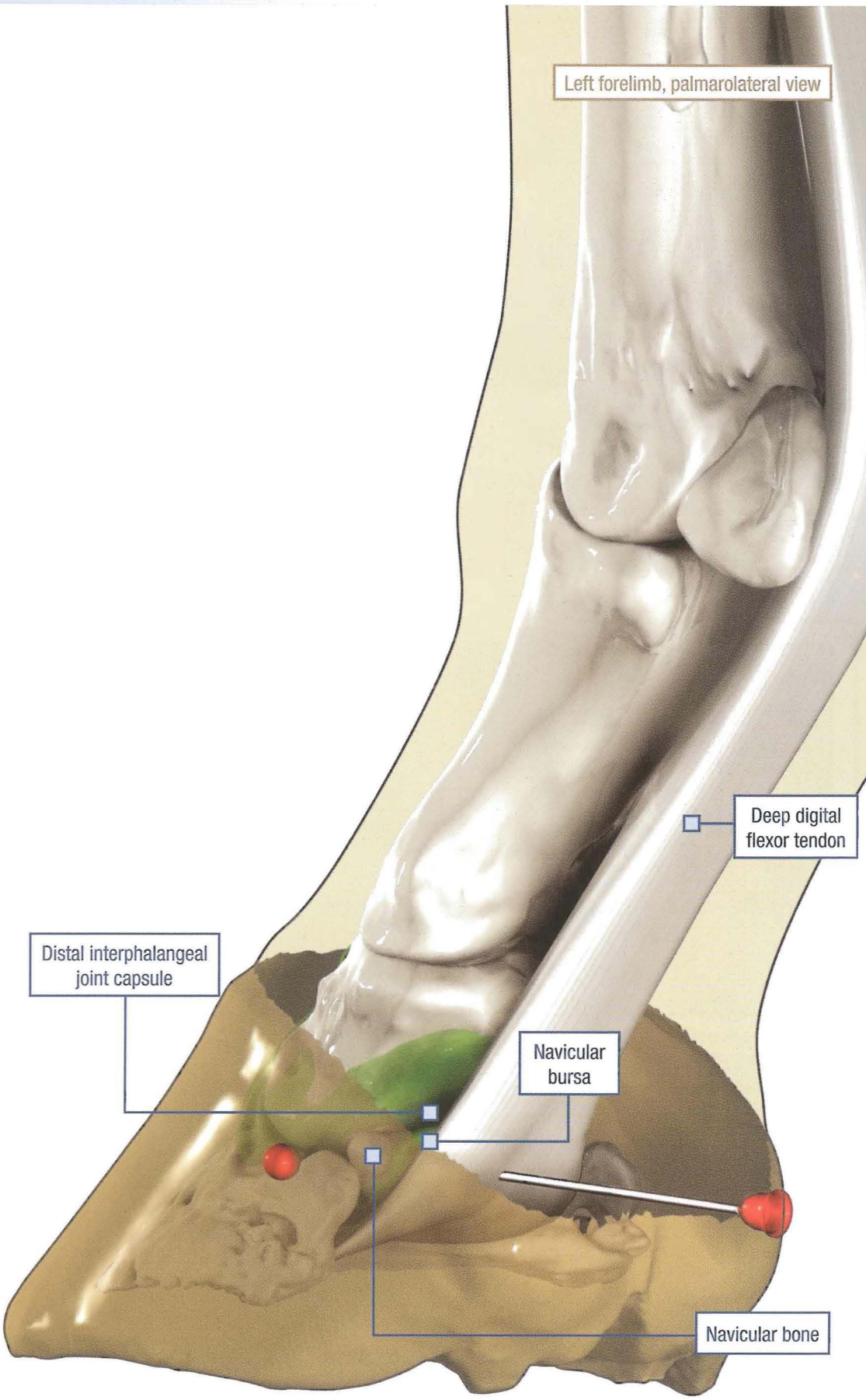
Performing the procedure with the limb in a weight-bearing position may also decrease the likelihood of inadvertently entering the navicular bursa or digital tendon sheath, but the procedure is more safely performed with the limb in a non–weight-bearing position.

Palpate the proximal edge of the lateral collateral cartilage of the foot, approximately midway between the dorsal and palmar/plantar aspects of the middle phalanx. *Note: Needle is in the right forelimb.*

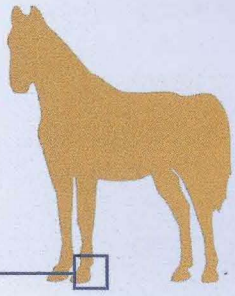
Insert the needle and angle it distally, aiming toward the medial aspect of the weight-bearing surface of the foot. *Note: Needle is in the right forelimb.*

NAVICULAR BURSA

VERSCHOOTEN APPROACH

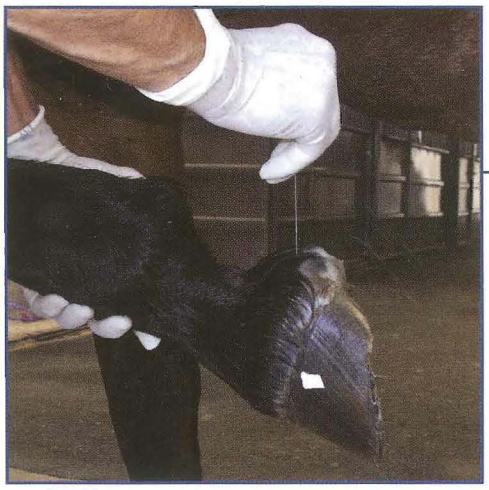


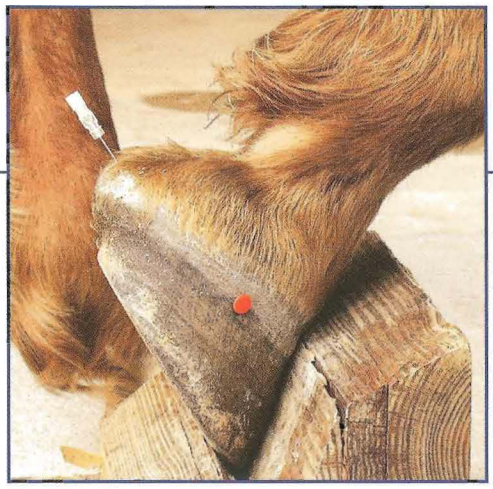
Needle: 3.5 in. (9 cm), 20 ga, spinal
Volume: 2 to 4 mL
Degree of difficulty: 2/3



The **navicular bursa** (bursa podotrochlearis manus) can be entered using several approaches. We prefer the approach described by Verschooten et al[31] and Schramme et al.[32] To inject the bursa, insert a 3.5-inch (9-cm), 20-gauge, disposable spinal needle midway between the bulbs of the heel, immediately proximal to the coronary band, with the limb held or positioned in a Hickman block. Advance the needle along the sagittal plane of the foot toward the bisecting point between the sagittal plane and the long axis of the navicular bone. The long axis of the navicular bone is halfway between the most dorsal and the most palmar or plantar aspects of the coronary band, about 0.5 inch (1.3 cm) distal to the coronary band. Advance the needle until the tip contacts bone. Depth of insertion is about 1.5 to 2 inches (3.8 to 5 cm) for most horses, and synovial fluid is seldom obtained. The needle is determined to be within the navicular bursa by low resistance to injection and the ability to aspirate the injected contents back into the syringe.

If resistance to injection is encountered, the distal portion of the limb should be flexed more rigorously to enlarge the bursal space. To confirm that the needle is within the bursa, the foot can be





To inject the **bursa**, insert a 3.5-inch (9-cm), 20-gauge, disposable spinal needle through desensitized skin midway between the bulbs of the heel, immediately proximal to the coronary band, with the limb held (*left; needle is in the left forelimb)* or positioned in a Hickman block (*right; needle is in the right forelimb*), and direct it toward the navicular bone (the navicular bone is always in the same position in relation to the coronary band, regardless of the conformation of the foot). The *red tack* shows the approximate location of the navicular bone, called the *navicular position.*

It may be easier to inject medication into the **navicular bursa** if the distal portion of the limb is flexed. *Note: Needle is in the left forelimb.*

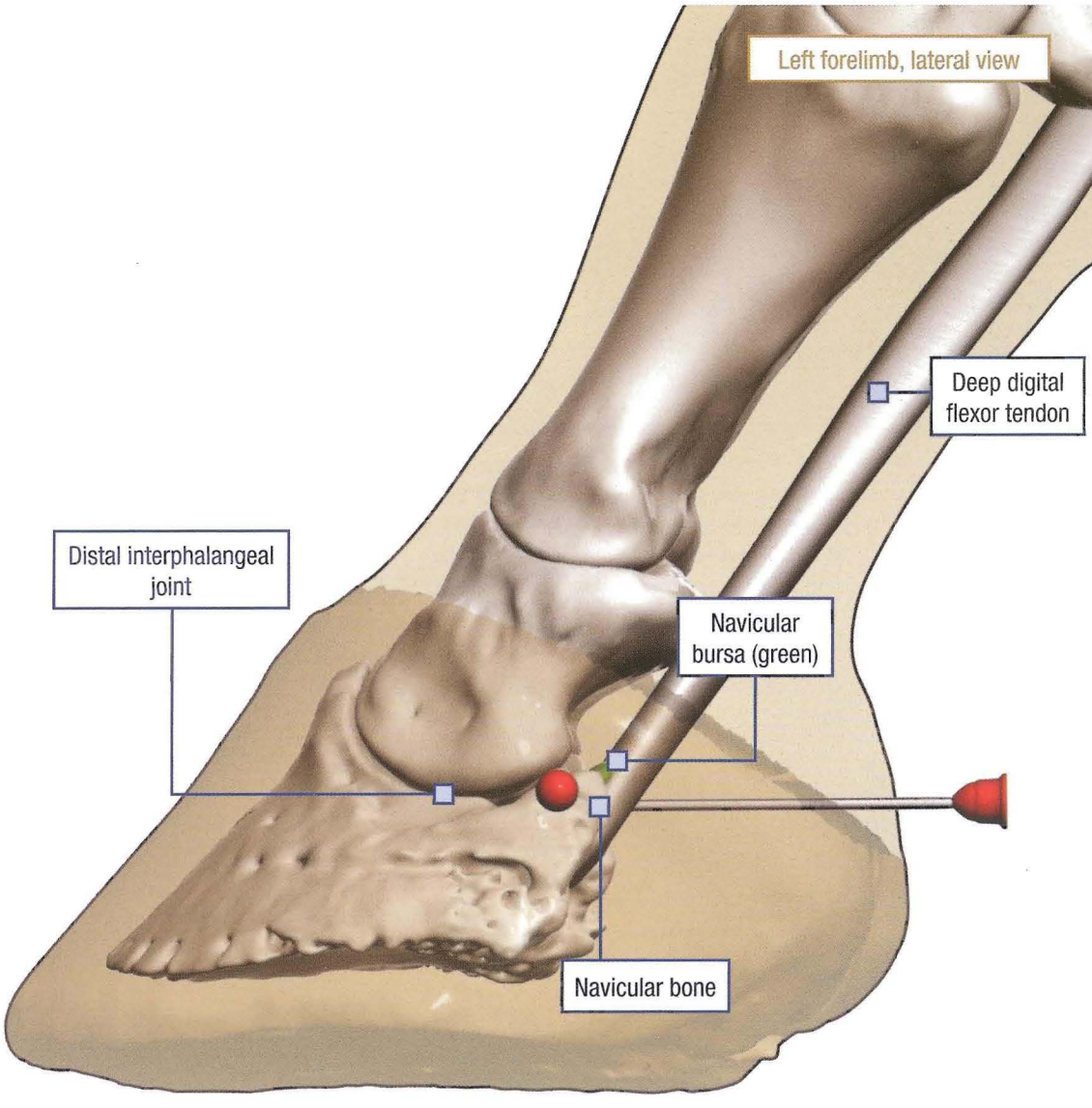
NAVICULAR BURSA

CONTINUED

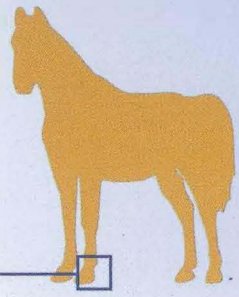
examined radiographically immediately before injecting the bursa. Radiologic identification of contrast medium (which can be injected with the anesthetic solution) within the bursa after injection is evidence of a successful bursal injection.

Successful centesis of the navicular bursa can also be determined ultrasonographically.[33] To image the navicular bone ultrasonographically, the frog is trimmed to pliable tissue and then soaked in warm water for 30 to 120 minutes; the time of soaking depends on the moisture content of the frog.[34] The needle is advanced into the navicular bursa, using Verschooten's method of centesis,[31,32] and the position of the needle tip is determined using a 7.5-MHz linear probe placed on the frog in a sagittal orientation.[33] The needle is properly placed when the tip of the needle contacts the flexor surface of the navicular bone.

In the absence of radiographic or ultrasonographic equipment, successful centesis of the bursa might be assumed if the first 2 mL of local anesthetic solution is easily administered and then, as an additional 1 to 2 mL is administered, pressure within the bursa increases, making administration more

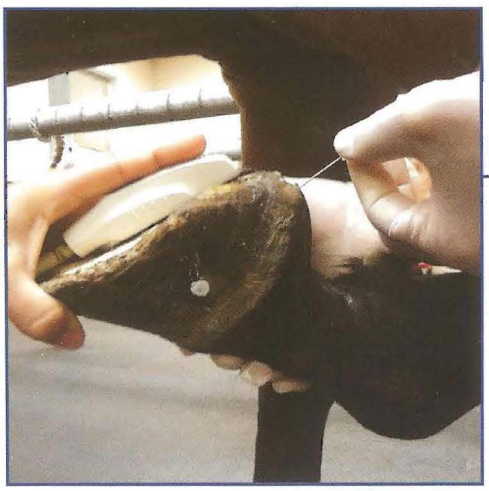


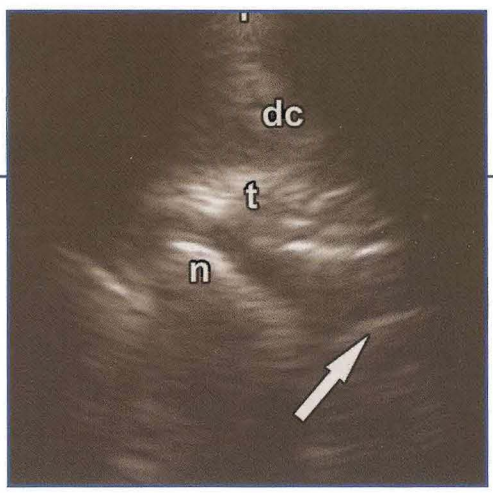
Needle: 3.5 in. (9 cm), 20 ga, spinal
Volume: 2 to 4 mL
Degree of difficulty: 2/3



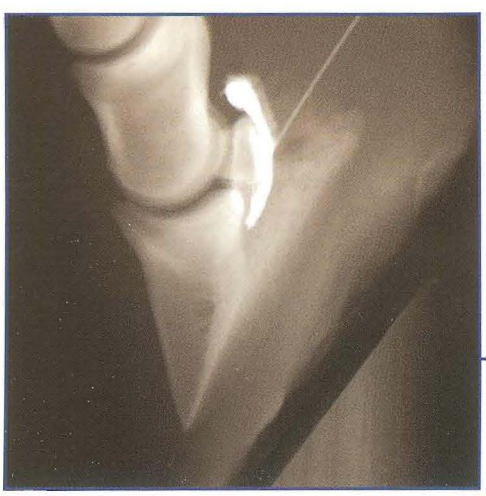
difficult and resulting in refilling of the syringe barrel with local anesthetic solution when pressure on the plunger is released. When the tip of the needle is inserted too far proximally, it passes proximal to the navicular bone to enter the palmar pouch of the coffin joint, allowing a much larger volume of anesthetic solution (e.g., >7 mL) to be administered before pressure is encountered. Synovial fluid can usually be aspirated from the palmar pouch of the coffin joint but not from the navicular bursa.

A positive response to administration of local anesthetic solution into the navicular bursa indicates that the site of lameness-inducing pain is the navicular apparatus,[18] solar toe,[4] or disease of the distal portion of the deep digital flexor tendon.[35,36] Whereas anesthesia of the coffin joint desensitizes the navicular apparatus, anesthesia of the navicular bursa has little effect on pain originating in the coffin joint.[35,37] The reason for this observation may be that the navicular bursa block and the coffin joint block anesthetize the palmar digital nerve at different sites (see illustration on page 17). Another explanation is that local anesthetic solution may diffuse more slowly from the navicular bursa to the coffin joint than from the coffin joint to the navicular bursa.[28,38,39]





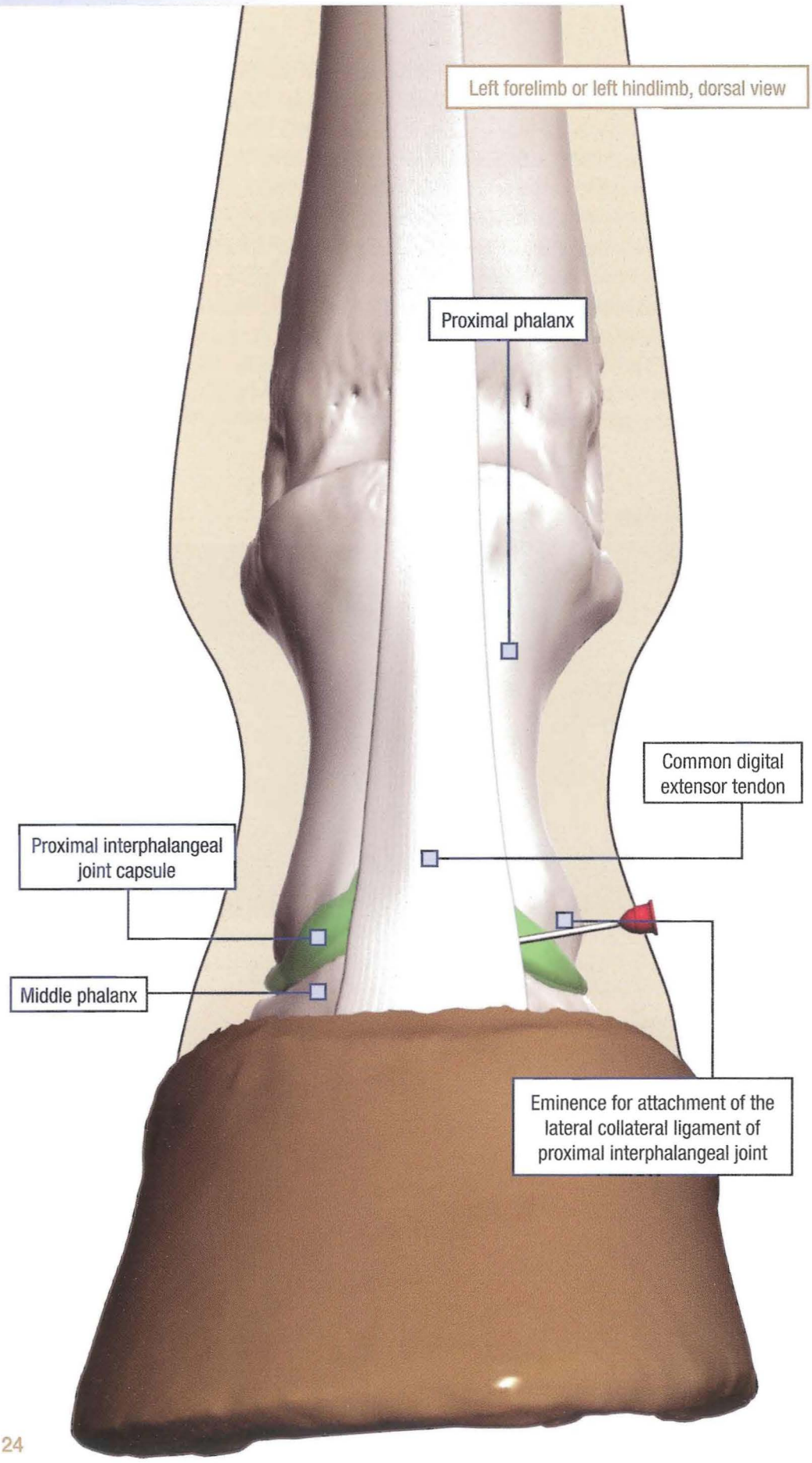
Using ultrasonography to verify the position of the needle tip during centesis of the **navicular bursa**, a 7.5-MHz linear probe is placed on the frog in a sagittal orientation after the needle has been advanced into the navicular bursa, using Verschooten's method of centesis. The needle (*arrow*) is properly placed when the tip of the needle contacts the flexor surface of the navicular bone. *Note: Needle is in the right forelimb.* (*dc* = digital cushion; *t* = tendon; *n* = navicular bone)



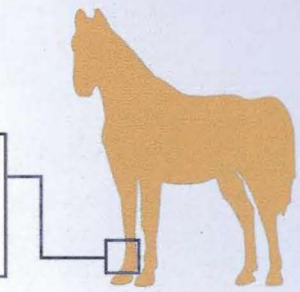
Radiologic identification of contrast medium (which can be injected with local anesthetic solution) within the **bursa** after injection is evidence of a successful bursal injection.

PROXIMAL INTERPHALANGEAL JOINT

DORSAL APPROACH



Needle: 1 to 1.5 in. (2.5 to 3.8 cm), 20 ga
Volume: 8 to 10 mL
Degree of difficulty: 2/3



The **proximal interphalangeal joint** (P1–P2, pastern joint) is usually easy to enter, particularly with an appreciation of the anatomy of the pastern area. The dorsal approach described here is a variation of dorsal approaches described previously.[40–42]

The dorsal pouch of the joint can be entered with the limb either bearing weight or held. We prefer the weight-bearing position when using the technique described here. Palpate the eminence on the distolateral aspect of the proximal phalanx. This eminence acts as the proximal attachment of the lateral collateral ligament of the pastern joint. Direct the point of the needle under the edge of the common digital extensor tendon, 0.5 inch (1.3 cm) distal to the level of the lateral eminence on the distal end of the proximal phalanx. Direct the needle medially and parallel to the ground. The joint is usually penetrated at a depth of about 0.5 inch (1.3 cm).

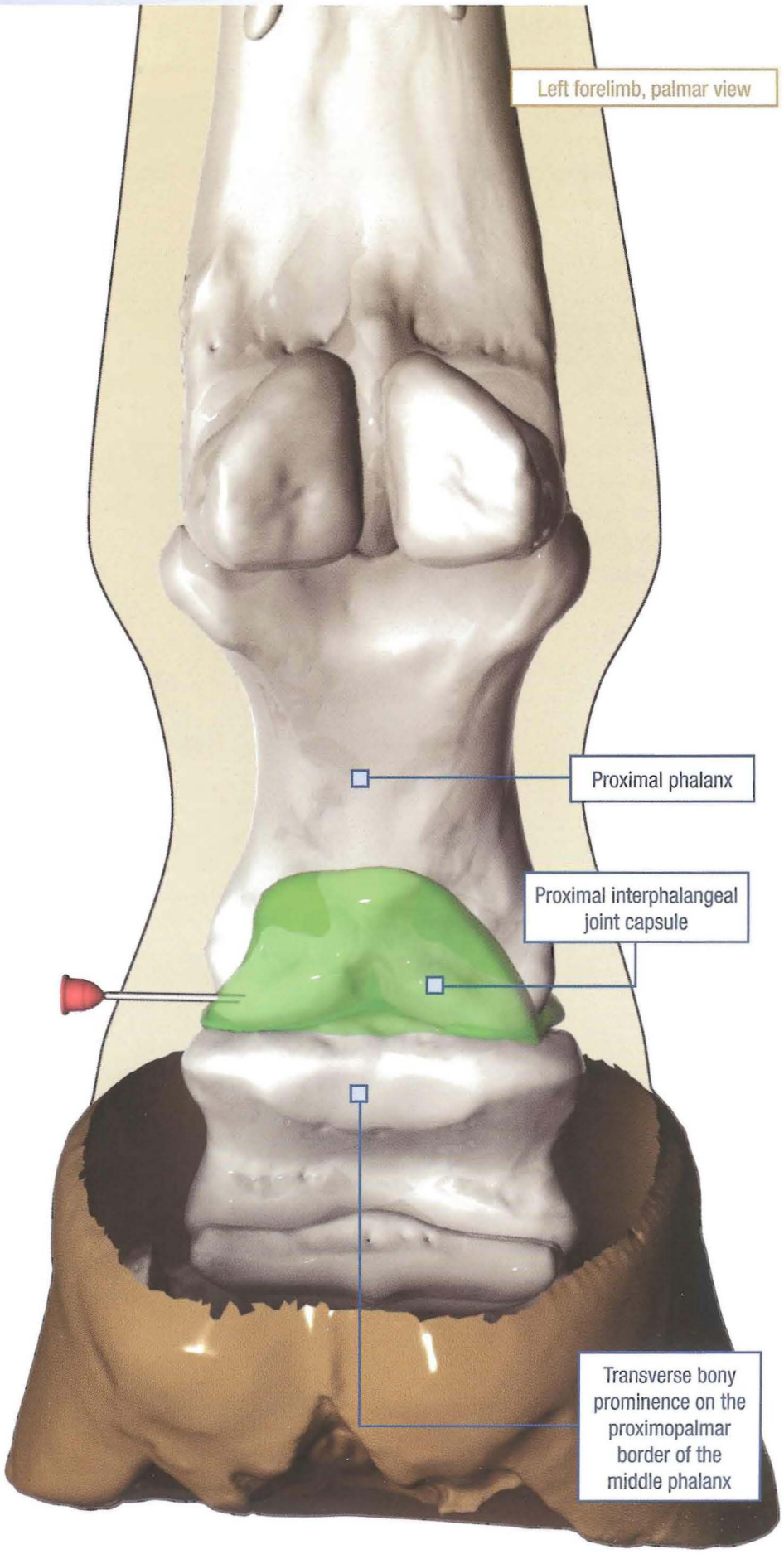
Palpate the medial or lateral bony eminence on the distal aspect of the proximal phalanx. *Note: The left forelimb is being palpated.*

Insert the needle at the edge of the common digital extensor tendon, 0.5 inch (1.3 cm) distal to the level of the lateral eminence on the distal end of the proximal phalanx, and position it parallel to the ground. Usually, the needle penetrates the joint at a depth of approximately 0.5 inch (1.3 cm). *Note: Needle is in the left forelimb.*

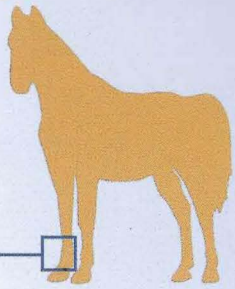
The needle in place. *Note: Needle is in the left forelimb.*

PROXIMAL INTERPHALANGEAL JOINT

PALMAR/PLANTAR APPROACH



Needle: 1.5 in. (3.8 cm), 20 ga
Volume: 8 to 10 mL
Degree of difficulty: 2/3



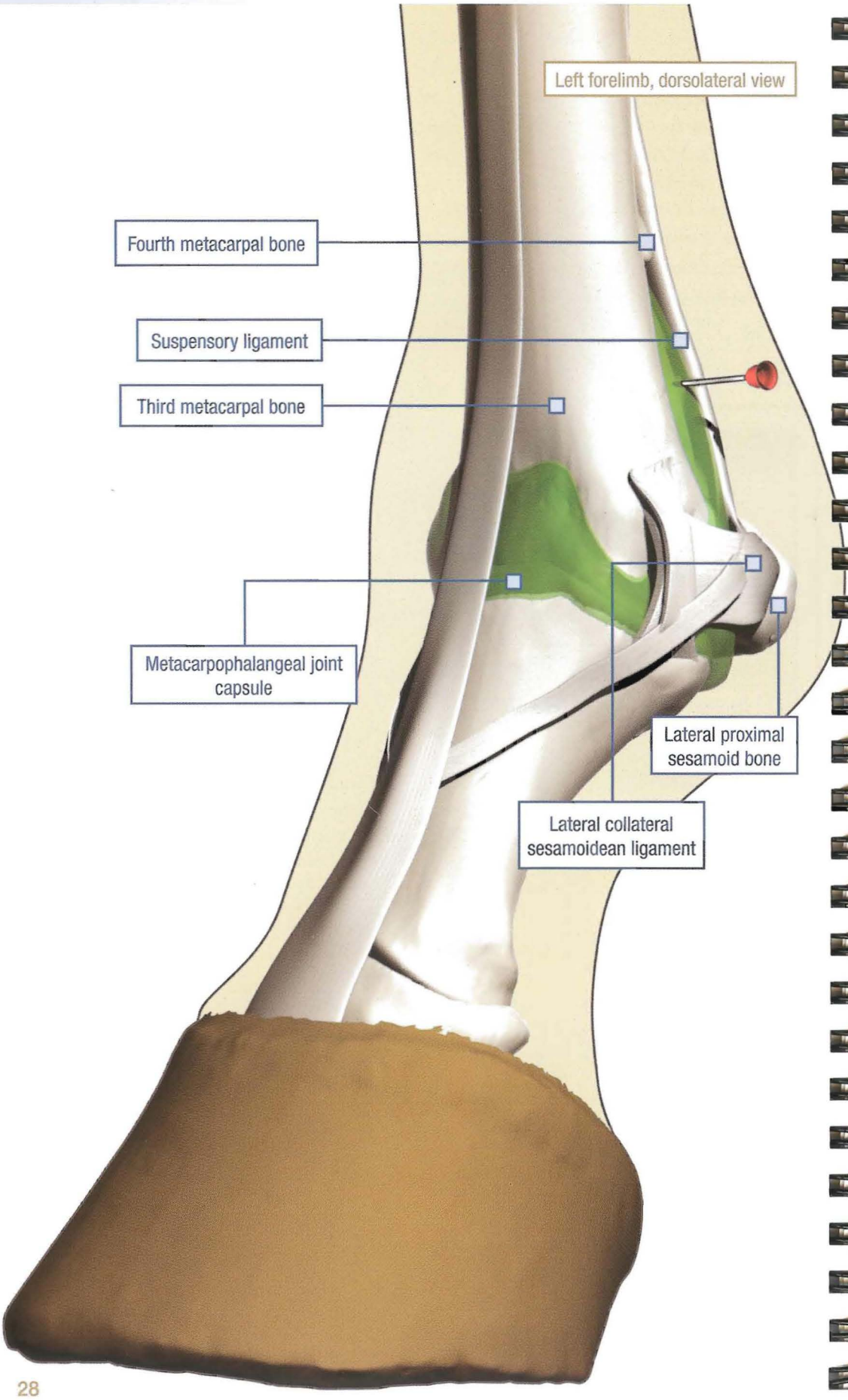
The landmarks for the palmar/plantar approach to the **proximal interphalangeal joint** (P1–P2, pastern joint) are more obvious than the landmarks for the dorsal approach. Using the palmar/plantar approach, the foot is held, making this approach safer for the clinician than the dorsal approach. Although the landmarks may be easier to palpate with the pastern extended rather than flexed, the procedure is performed with the distal portion of the limb flexed. Insert the needle perpendicular to the sagittal plane of the proximal phalanx just above the transverse bony prominence on the proximopalmar/plantar aspect of the middle phalanx close to the palmar/plantar surface of the proximal phalanx. The needle penetrates the palmar/plantar pouch of the pastern joint at a depth of about 1 inch (2.5 cm). Synovial fluid often drips from the needle.

Palpate the transverse bony prominence on the proximopalmar/proximoplantar aspect of the middle phalanx. *Note: Needle is in the left forelimb.*

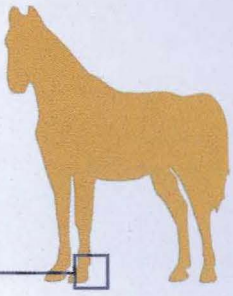
Insert the needle perpendicular to the sagittal plane of the proximal phalanx just proximal to the transverse bony prominence on the proximopalmar/proximoplantar aspect of the middle phalanx close to the palmar/plantar surface of the proximal phalanx. *Note: Needle is in the left forelimb.*

METACARPOPHALANGEAL/ METATARSOPHALANGEAL JOINT

APPROACH TO THE PROXIMAL PALMAR/PLANTAR POUCH



Needle: 1 in. (2.5 cm), 20 ga
Volume: 8 to 12 mL
Degree of difficulty: 1/3



The **metacarpophalangeal/metatarsophalangeal joint** (MCIII/MTIII–P1, fetlock joint, ankle) is one of the most easily and commonly injected joints. The decision to inject it with the limb bearing weight or held depends on the clinician's preference and the horse's behavior. However, distention of the joint capsule is most easily visualized when the limb is bearing weight.

The joint can be approached through the lateral aspect of the palmar/plantar pouch (proximal extension of the joint capsule), which is located between the following palpable structures: (1) the palmarodistal/plantarodistal aspect of the third metacarpal/metatarsal bone (cannon bone); (2) the dorsal edge of the lateral branch of the suspensory ligament; (3) the distal end of the fourth metacarpal/metatarsal bone (lateral splint bone); and (4) the lateral, proximal sesamoid bone and the lateral, collateral sesamoidean ligament. The pouch can be distended at the site of entry, making it more obvious, by applying digital pressure to the medial side of the palmar/plantar pouch before inserting the needle.

Direct the needle at a slightly downward angle into the middle of the lateral aspect of the palmar/plantar pouch. The joint capsule is usually very superficial and is often penetrated at a depth of 0.25 to 0.5 inch (0.6 to 1.3 cm).

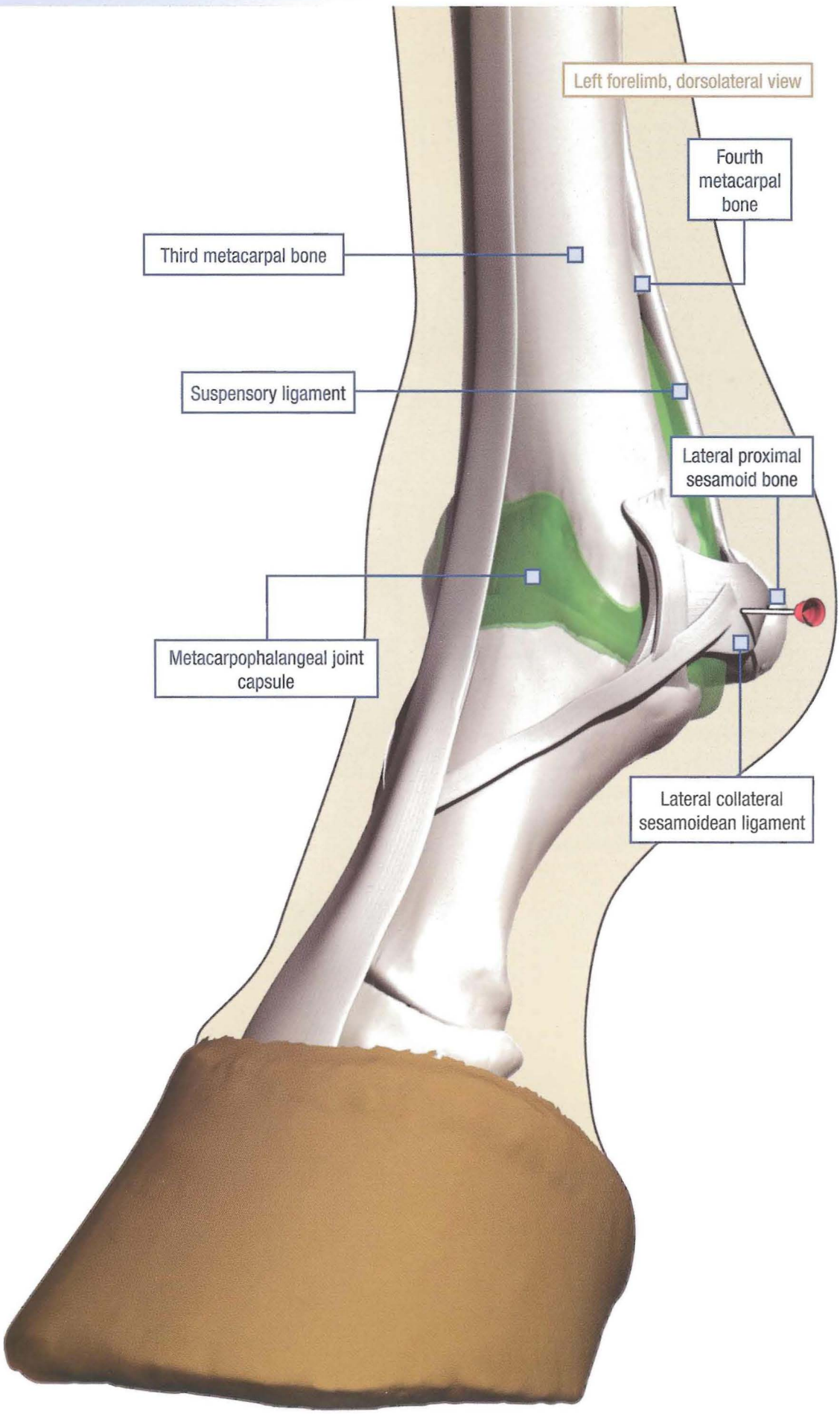
Palpate and identify the lateral aspect of the **palmar/plantar pouch** of the fetlock joint. The pouch is bordered by the palmarodistal/plantarodistal aspect of the third metacarpal/metatarsal bone; the dorsal edge of the lateral branch of the suspensory ligament; the distal end of the fourth metacarpal/metatarsal bone; and the lateral, proximal sesamoid bone. *Note: Needle is in the left forelimb.*

Insert the needle into the lateral aspect of the **palmar/plantar pouch** of the fetlock joint. The joint capsule is superficial if distended. *Note: Needle is in the left forelimb.*

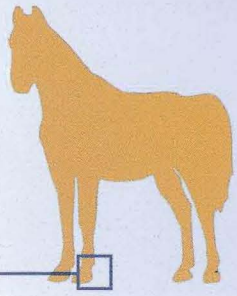
An alternative method of injecting the fetlock involves holding the limb in flexion. Insert the needle into the lateral aspect of the **palmar/plantar pouch**. *Note: Needle is in the left forelimb.*

METACARPOPHALANGEAL/ METATARSOPHALANGEAL JOINT

COLLATERAL SESAMOIDEAN LIGAMENT APPROACH

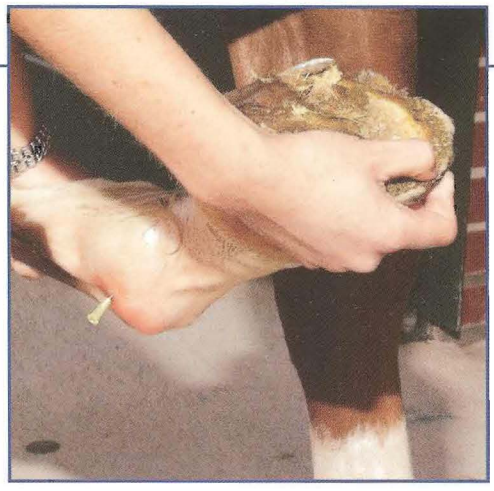


Needle: 1 in. (2.5 cm), 20 to 22 ga
Volume: 8 to 12 mL
Degree of difficulty: 1/3



The **metacarpophalangeal/metatarsophalangeal joint** (MCIII/MTIII–P1, fetlock joint, ankle) can also be entered between the lateral (or medial) palmar/plantar aspect of the articular surface of the third metacarpal/metatarsal bone and the articular surface of the lateral (or medial) proximal sesamoid bone. The articular margin of both bones is easily palpated. The procedure is performed with the limb in the flexed, non–weight-bearing position. This technique requires a 1-inch (2.5-cm), 20- to 22-gauge needle. Direct the needle perpendicular to the lateral (or medial) surface of the joint to penetrate the lateral (or medial) collateral sesamoidean ligament.[43] This approach is less likely to cause hemorrhage within the joint than the approach through the palmar/plantar pouch.

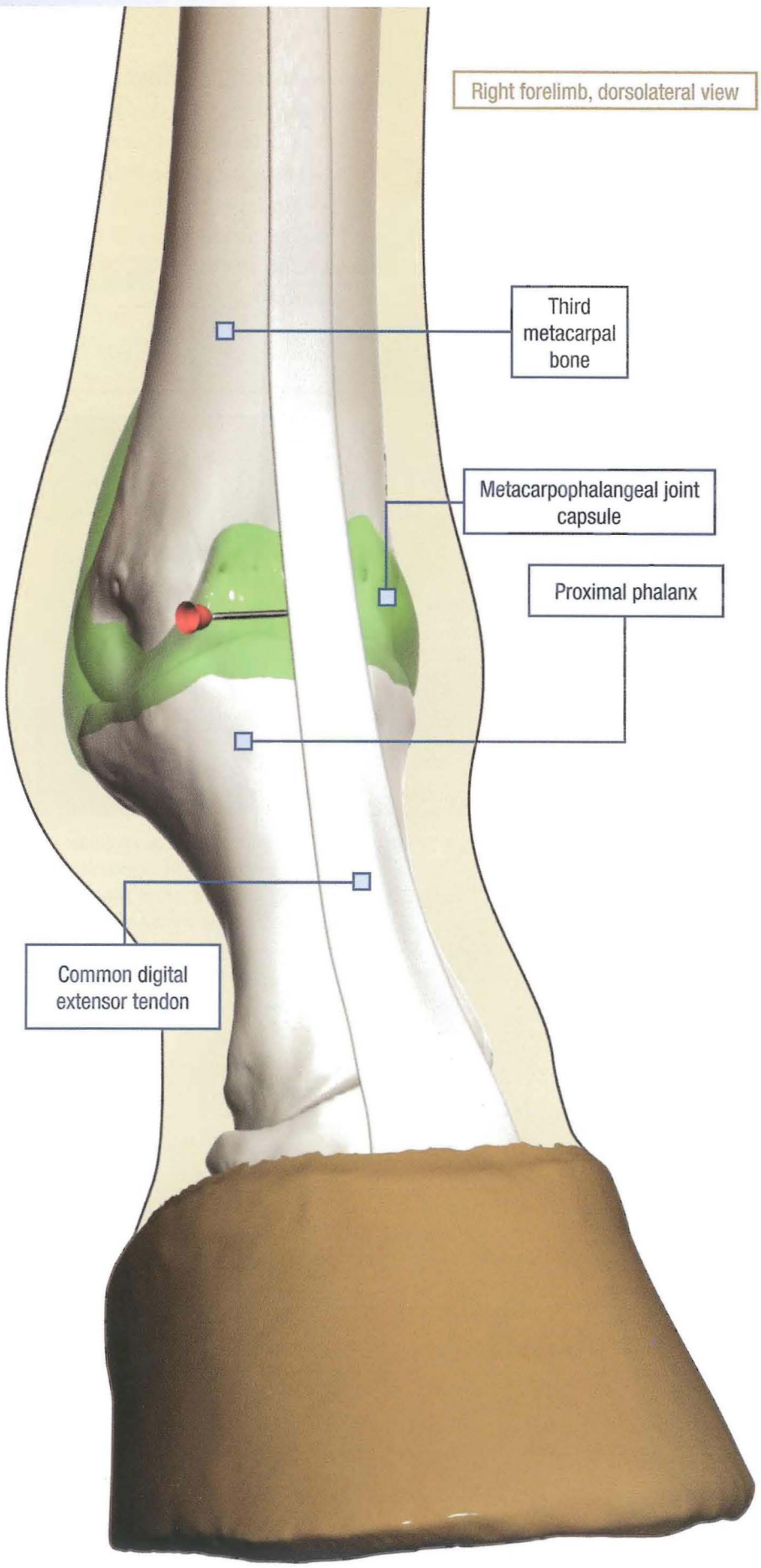
Palpate the lateral, palmar/plantar aspect of the articular surface of the third metacarpal/metatarsal bone and the articular surface of the lateral proximal sesamoid bone. *Note: Needle is in the left forelimb.*



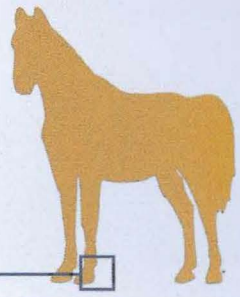
Direct the needle perpendicular to the lateral surface of the metacarpophalangeal/metatarsophalangeal joint, and penetrate the lateral collateral sesamoidean ligament. *Note: Needle is in the left forelimb.*

METACARPOPHALANGEAL/ METATARSOPHALANGEAL JOINT

DORSAL APPROACH



Needle: 1 in. (2.5 cm), 20 to 22 ga
Volume: 8 to 12 mL
Degree of difficulty: 1/3

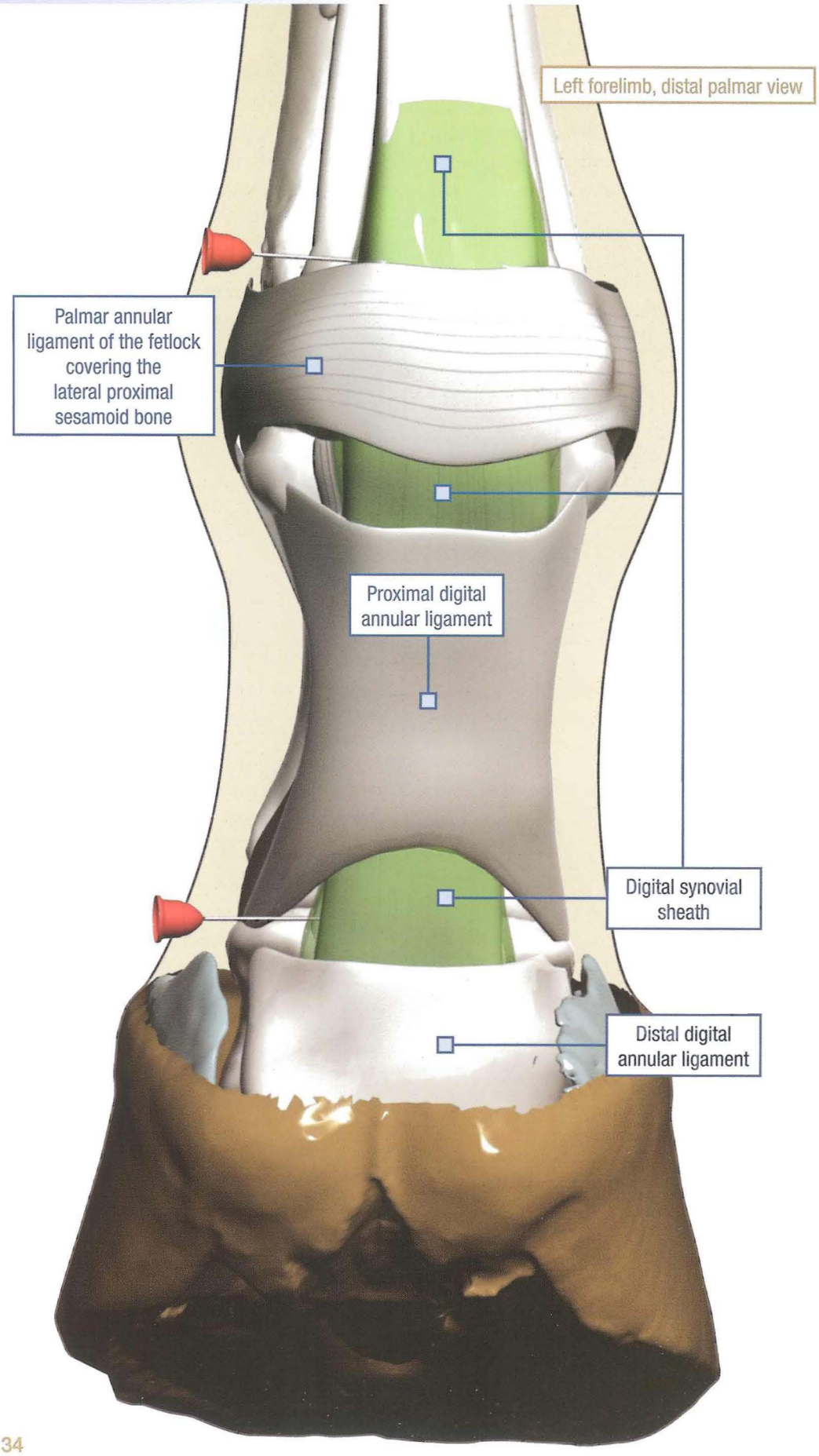


The alternate route of entry is through the dorsal aspect of the **metacarpophalangeal/metatarsophalangeal joint** (MCIII/MTIII–P1, fetlock joint, ankle) capsule at or slightly above the palpable joint space. Insert the needle under the lateral edge of the common digital extensor tendon and direct it medially and parallel to the frontal plane of the joint to enter the dorsal pouch of the joint. The capsule is thicker here than in the palmar/plantar pouch, and penetration is often met with greater resentment by the horse.

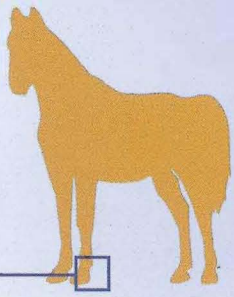
To enter the **dorsal pouch** of the metacarpophalangeal/metatarsophalangeal joint, insert the needle under the lateral edge of the common digital extensor tendon at or slightly above the palpable joint space and direct the needle medially and parallel to the frontal plane of the joint. *Note: Needle is in the left forelimb.*

DIGITAL SHEATH POUCHES

PROXIMAL OR DISTAL APPROACH



Needle: 1 in. (2.5 cm), 20 to 22 ga
Volume: 8 to 12 mL
Degree of difficulty: 2/3



The **digital synovial sheath** can be entered in one of the sheath's pouches, which are located in places where the sheath is not encased by annular ligaments. When the sheath is distended, the site for synoviocentesis is the most prominently distended pouch; when the sheath is not distended, the clinician must have good knowledge of the location of the pouches.

The digital synovial sheath can be entered proximal to the palmar annular ligament of the fetlock joint about 1 inch (2.5 cm) proximal to the proximal aspect of the proximal sesamoid bone between the deep digital flexor tendon and the medial or lateral branch of the suspensory ligament. Synoviocentesis of the sheath at this location is difficult unless it is distended with fluid.

The sheath can be entered on the palmar/plantar aspect of the pastern between the proximal and distal digital annular ligaments and between the diverging branches of the superficial digital flexor tendon, where the deep digital flexor tendon lies close to the skin. The point of the needle must remain superficial to the deep digital flexor tendon.

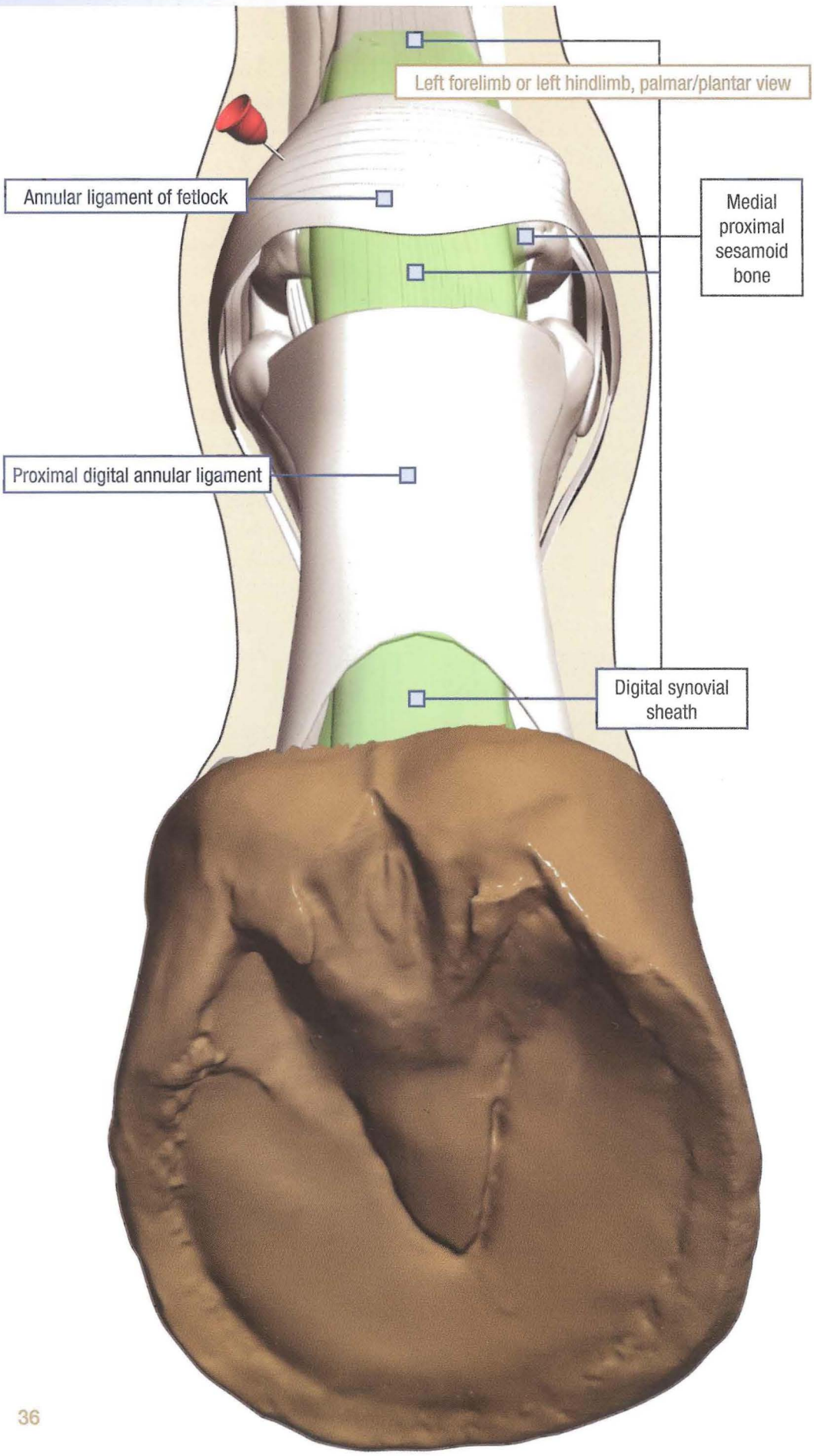
The sheath can also be entered at its proximal or distal collateral pouches. The proximal collateral pouches are located palmaromedially and palmarolaterally between the palmar annular ligament of the fetlock joint and the proximal digital annular ligament. Either proximal pouch can be entered 0.5 inch (1.3 cm) distal to the base of ipsilateral proximal sesamoid bone and 0.5 inch (1.3 cm) palmar/plantar to the neurovascular bundle. The distal collateral pouches can be entered on the lateral or medial aspect of the pastern between the proximal and distal attachments of the proximal digital annular ligament and between the flexor tendons and the distal sesamoidean ligament.

The **digital synovial sheath** can be entered on the palmar/plantar aspect of the proximal interphalangeal joint between the proximal and distal digital annular ligaments and the diverging branches of the superficial digital flexor tendon, where the deep digital flexor tendon lies close to the skin. The point of the needle must remain superficial to the deep digital flexor tendon. *Note: Needle is in the left forelimb.*

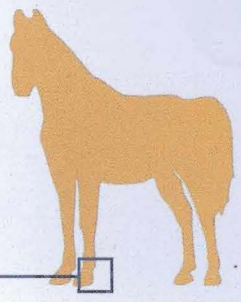
To perform the palmar axial sesamoidean approach for synoviocentesis of the **digital synovial sheath**, insert the needle through the palmar/plantar annular ligament of the fetlock. With the limb flexed, place the needle through the skin at the level of the midbody of the lateral proximal sesamoid bone, and advance it through the palmar/plantar annular ligament, 3 mm axial to the palpable palmar/plantar border of the lateral proximal sesamoid bone and immediately palmar/plantar to the palmar/plantar digital neurovascular bundle. Insert the needle in a transverse plane and advance it at an angle to the sagittal plane, aiming toward the central intersesamoidean region, to a depth of about 0.5 to 0.75 inch (1.3 to 1.9 cm). *Note: Needle is in the left forelimb.*

DIGITAL SHEATH POUCHES

PALMAR/PLANTAR AXIAL SESAMOIDEAN APPROACH

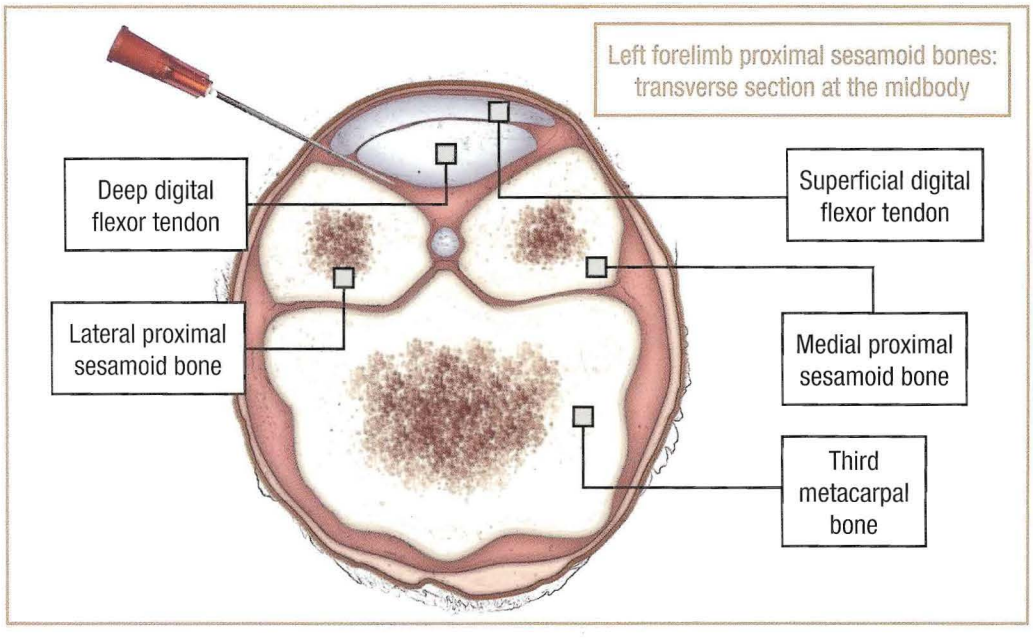


Needle: 1 in. (2.5 cm), 20 to 22 ga
Volume: 8 to 12 mL
Degree of difficulty: 2/3



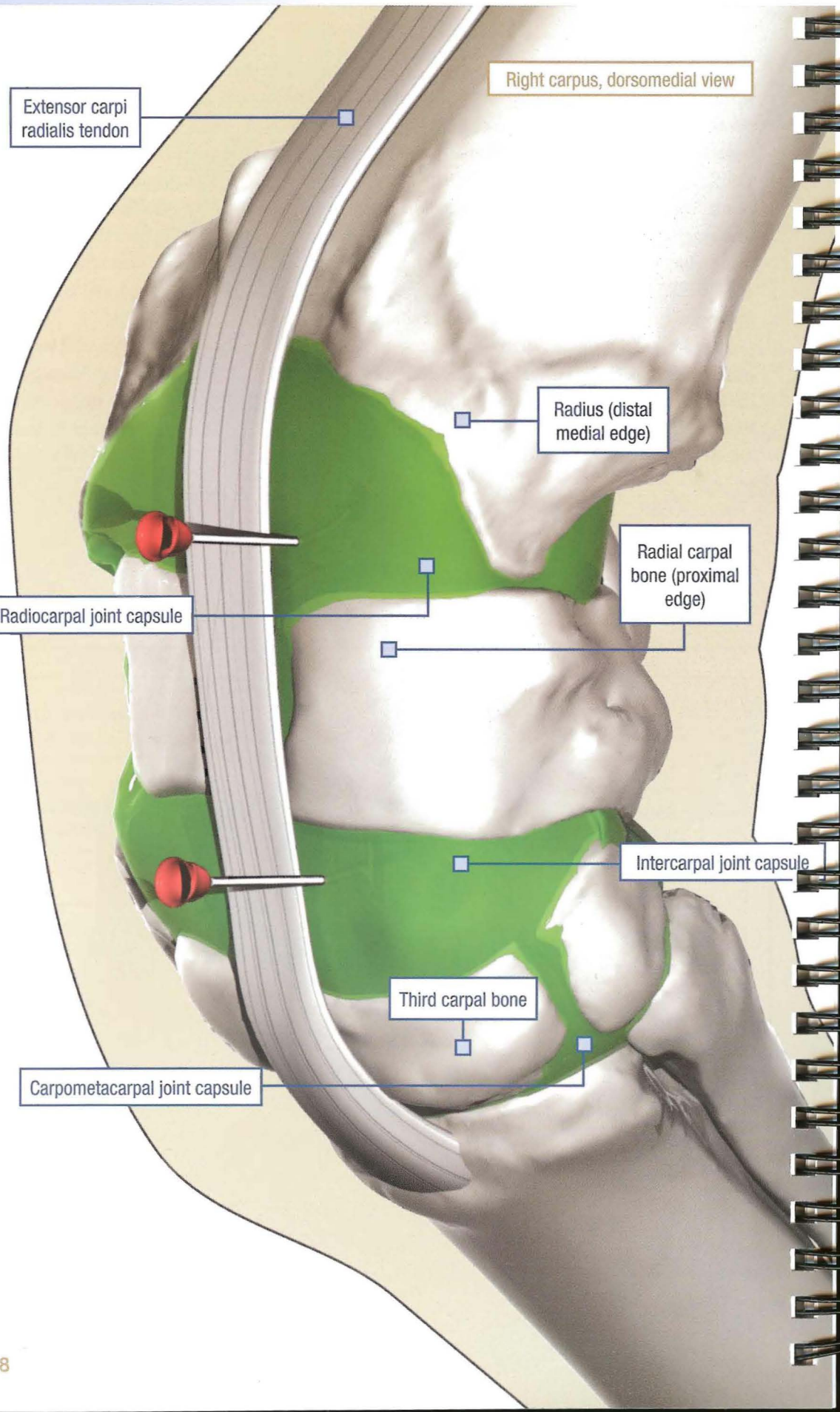
Using the palmar/plantar axial sesamoidean approach for synoviocentesis of the **digital synovial sheath**, insert the needle through the palmar/plantar annular ligament of the fetlock.[44] With the limb flexed, place the needle through the skin at the level of the midbody of the lateral proximal sesamoid bone, and advance it through the palmar/plantar annular ligament 3 mm axial to the palpable palmar/plantar border of the lateral proximal sesamoid bone and immediately palmar/plantar to the palmar/plantar digital neurovascular bundle. Insert the needle in a transverse plane and advance it at an angle to the sagittal plane, aiming toward the central intersesamoidean region to a depth of about 0.5 to 0.75 inch (1.3 to 1.9 cm). The palmar axial sesamoidean approach is reliable for consistent synoviocentesis of the digital flexor tendon sheath, even when the sheath is not distended with fluid, and is less likely than other approaches to result in synovial hemorrhage.

Anesthesia of the digital synovial sheath desensitizes the structures contained within, and based on results of an anatomic study and clinical observations, the portion of the deep digital flexor tendon distal to the digital synovial sheath.[45,46] The deep digital flexor tendon within the foot may receive its sensory supply from deep branches of the medial and lateral palmar digital nerves that enter the sheath. These branches are anesthetized by an abaxial sesamoid nerve block.

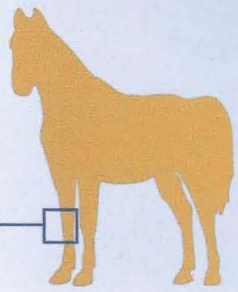


CARPUS

DORSAL APPROACH



Needle: 1 to 1.5 in. (2.5 to 3.8 cm), 20 ga
Volume: 7 to 10 mL for each joint
Degree of difficulty: 1/3



The **radiocarpal and intercarpal joints** can be entered with ease. The **carpometacarpal joint** communicates with the intercarpal joint and, therefore, does not require separate entry.

Using the dorsal approach, enter the radiocarpal (antebrachiocarpal) or the intercarpal joints with the limb held and the carpus flexed. Locate the radiocarpal joint by palpating the medial aspect of the distal edge of the radius and the proximal edge of the radial carpal bone. Insert the needle midway between these two structures and medial to the medial edge of the palpable tendon of the extensor carpi radialis muscle. The joint capsule is penetrated at a depth of about 0.5 inch (1.3 cm).

Locate the intercarpal joint by palpating the distal edge of the radial carpal bone and the medial aspect of the proximal edge of the third carpal bone. The technique of needle insertion is similar to that for the radiocarpal joint.

It is important to point out that Ford et al[47] and Moyer et al[48] showed that the palmar outpouchings of the carpometacarpal joint capsule extend into the fibers of the proximal portion of the suspensory ligament. Therefore, one should assume that after injecting local anesthetic solution into the intercarpal joint, the solution enters the carpometacarpal joint and anesthetizes the origin of the suspensory ligament.

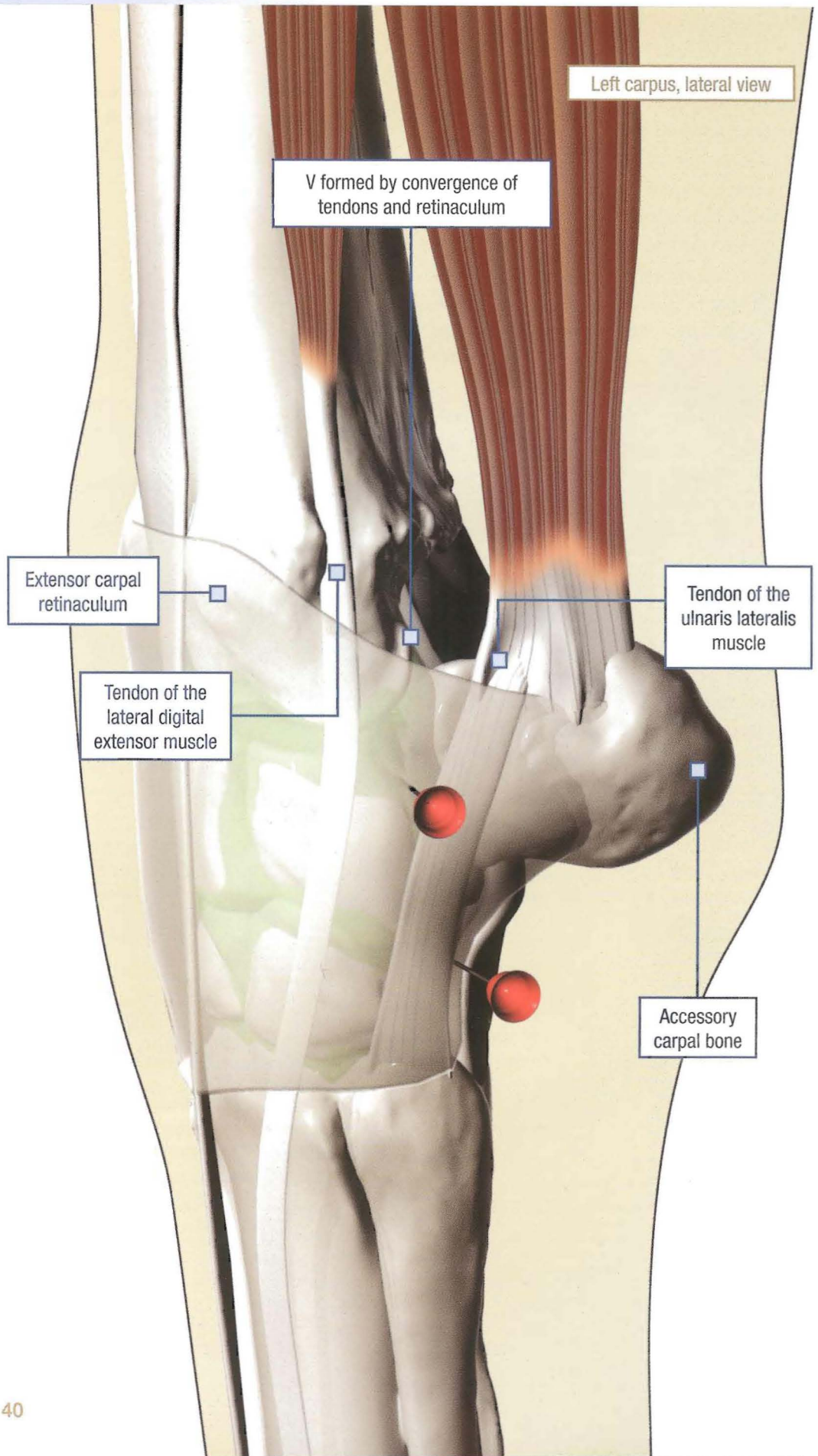
Palpate the **radiocarpal** and **intercarpal** joints medial to the palpable tendon of the extensor carpi radialis muscle. *Note: The right carpus is being palpated.*

Insert the needle into the **radiocarpal joint**, medial to the palpable tendon of the extensor carpi radialis muscle. *Note: Needle is in the right carpus.*

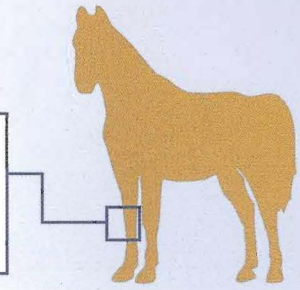
Insert the needle into the **intercarpal joint**, medial to the palpable tendon of the extensor carpi radialis muscle. *Note: Needle is in the right carpus.*

CARPUS

LATERAL APPROACH



Needle: 1 in. (2.5 cm), 20 to 22 ga
Volume: 7 to 10 mL for each joint
Degree of difficulty: 2/3



The lateral approach for entering the **carpal joints** is preferred by some veterinarians because the limb does not need to be held when using this approach and the risk of lacerating articular cartilage with the needle during insertion is less than when using the dorsal approach.[49] The lateral approach is relatively easy if the joint is distended by effusion.

With the horse bearing weight on the limb, palpate the tendons of the ulnaris lateralis and lateral digital extensor muscles on the palmarolateral aspect of the limb, above the carpus. The space between these two tendons is followed distally until the tendons and retinaculum converge to form a V. A small depression that can be palpated 0.5 to 1 inch (1.3 to 2.5 cm) distal to the V is the site of insertion of the needle for arthrocentesis of the radiocarpal joint. Insert the needle perpendicular to the skin surface. The joint is penetrated at a depth of about 0.5 inch (1.3 cm).

The intercarpal joint can be entered on the palmarolateral aspect of the carpus, with the horse bearing weight on the limb, in a slight depression located about 1 inch (2.5 cm) directly distal to the site of injection of the radiocarpal joint. Insert the needle perpendicular to the skin surface to a depth of about 0.5 inch (1.3 cm).

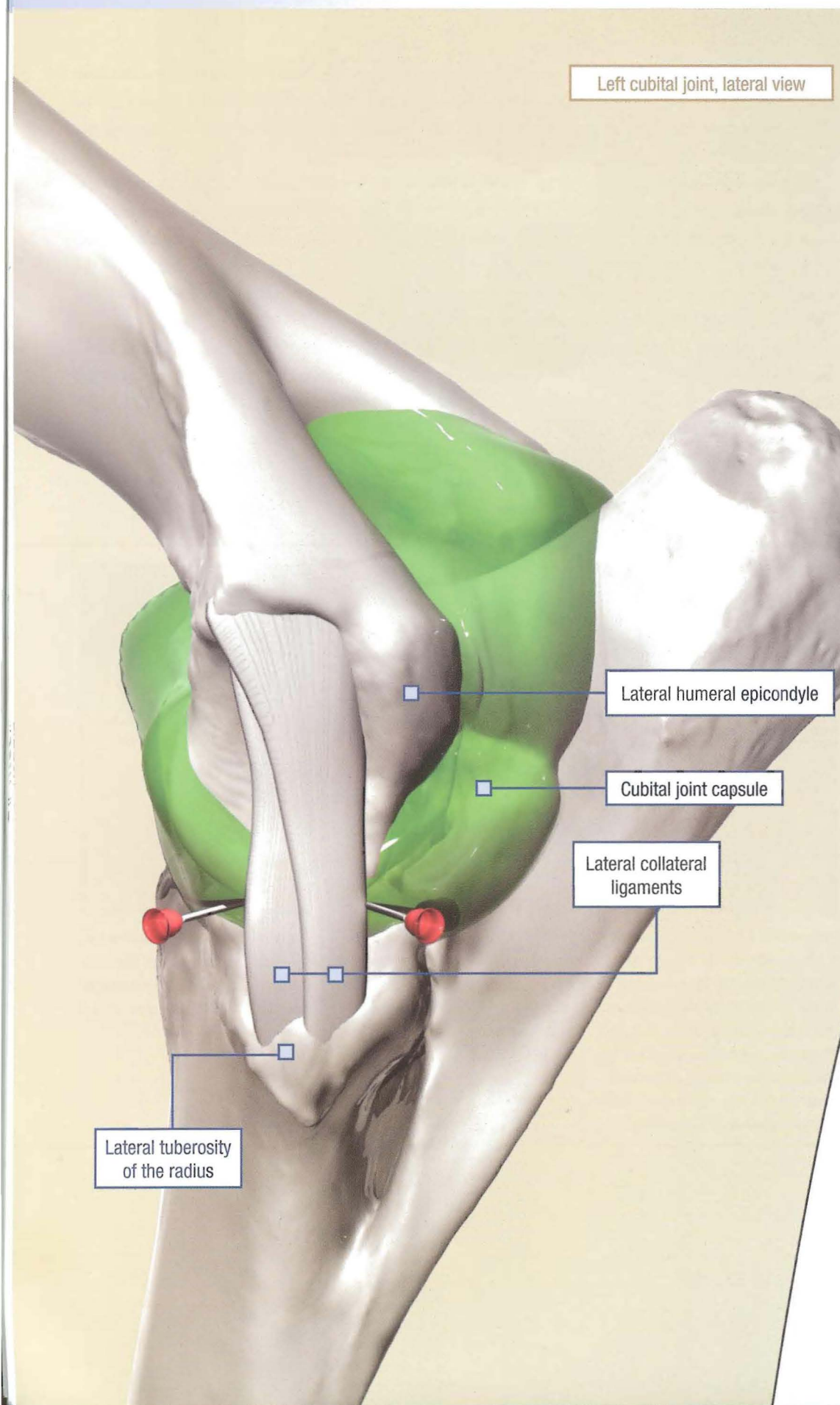
Palpate the depression found about 0.5 to 1 inch (1.3 to 2.5 cm) distal to the V created by the convergence of the tendons of the ulnaris lateralis and lateral digital extensor muscles. Insert the needle perpendicular to the skin surface into the **radiocarpal joint** through this depression. *Note: The left carpus is being palpated.*

Palpate the depression found about 1 inch (2.5 cm) distal to the palmarolateral site of injection of the radiocarpal joint. Insert the needle perpendicular to the skin surface into the **intercarpal joint**. *Note: The needle is in the left carpus.*

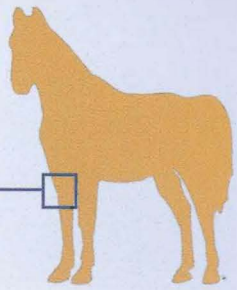
The proximal needle is placed into the **radiocarpal joint**, and the distal needle is placed into the **intercarpal joint**. *Note: The needles are in the left carpus.*

CUBITAL JOINT (ELBOW)

LATERAL APPROACH



Needle: 1.5 in. (3.8 cm), 20 ga
Volume: 20 to 30 mL
Degree of difficulty: 2/3



The **cubital joint** (elbow), or combined humeroradial, humeroulnar, and radioulnar joints, is not usually a source of lameness and, therefore, is rarely injected. With careful palpation, it is not a difficult joint to inject. The joint capsule of the elbow has cranial and caudal pouches. The palpable landmarks of the cranial pouch are the lateral humeral epicondyle, the lateral tuberosity of the radius, and the lateral collateral ligament of the elbow.

Using a lateral approach, insert the needle either cranial or caudal to the palpable edge of the lateral collateral ligament. The joint margin is approximately two-thirds of the distance, measured distally, from the lateral humeral epicondyle to the radial tuberosity. The depth of penetration is usually 1 inch (2.5 cm). In some cases, inadvertent deposition of local anesthetic solution outside the elbow joint may result in anesthesia of the radial nerve. For this reason we prefer to use lidocaine for this block because it provides a shorter duration of anesthesia.

The elbow joint communicates with the bursa of the ulnaris lateralis muscle in about one-third of horses.[50]

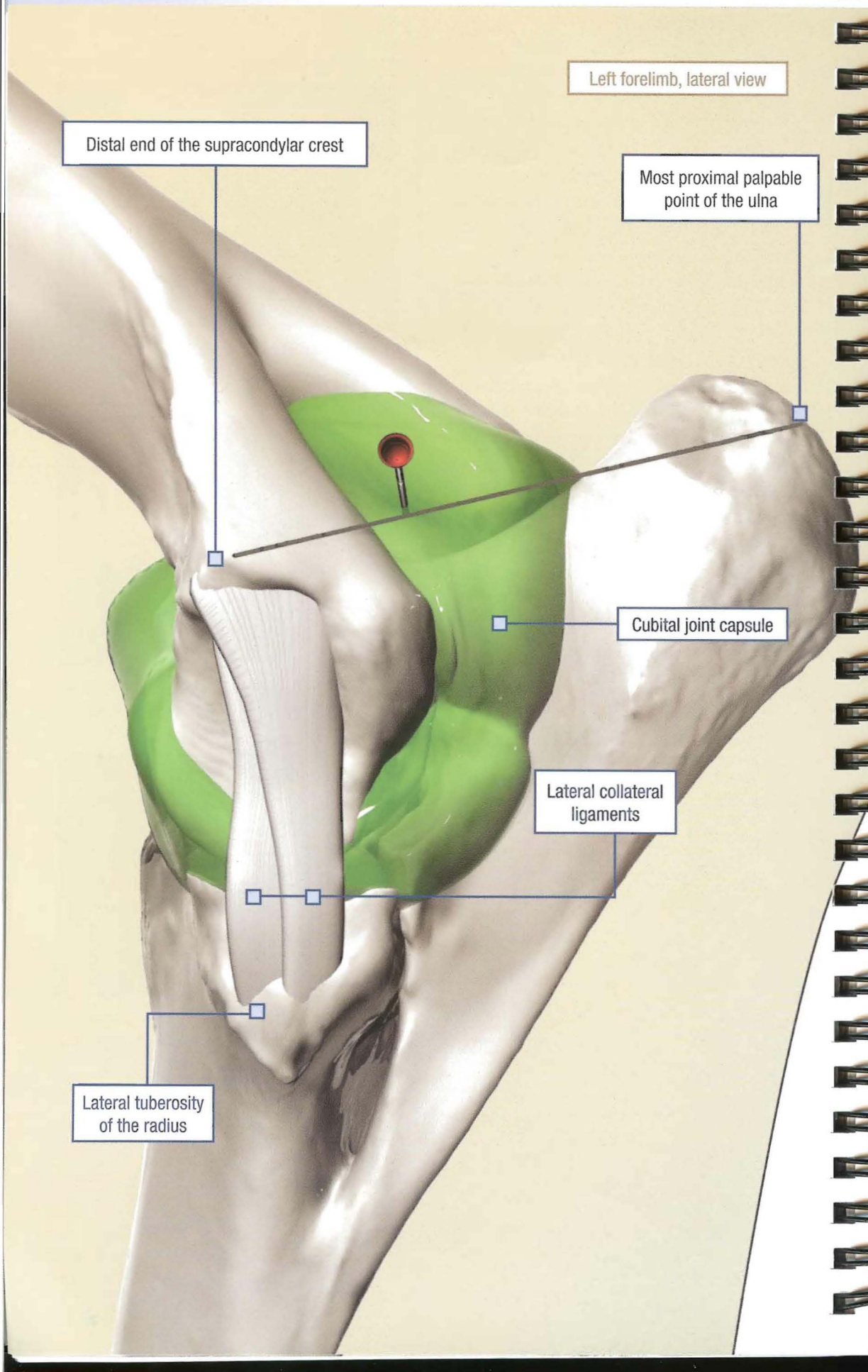
Palpate the lateral humeral epicondyle and the lateral tuberosity of the radius. *Note: The left forelimb is being palpated.*

Insert the needle cranial to the palpable edge of the lateral collateral ligament of the elbow. *Note: Needle is in the left forelimb.*

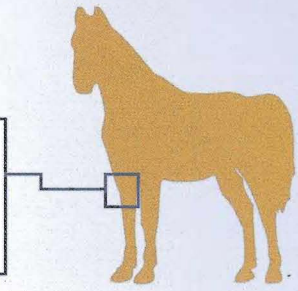
Alternatively, the needle can be inserted caudal to the palpable edge of the lateral collateral ligament of the elbow. *Note: Needle is in the left forelimb.*

CUBITAL JOINT (ELBOW)

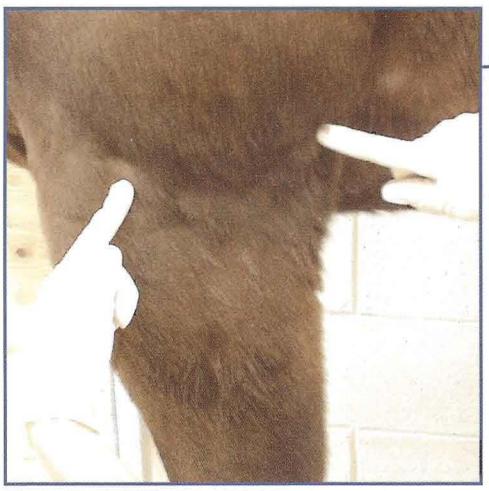
CAUDAL APPROACH



Needle: 3.5 in. (9 cm), 20 ga
Volume: 20 to 30 mL
Degree of difficulty: 2/3



A needle can be inserted into the large caudal pouch of the **cubital joint** (the combined humeroradial, humeroulnar, and radioulnar joints, or elbow joint) using a technique described by Sams et al,[50] Bertone et al,[51] and Goodman and Baker.[52] The site of insertion of the needle is a point 0.5 inch (1.3 cm) proximal to and one-third the distance caudally along a line between the distal end of the lateral supracondylar crest of the humerus and the most proximal palpable point of the ulna. Insert the needle into the olecranon fossa, in a distomedial direction, at an angle of approximately 45° from the vertical. The depth of needle insertion varies from about 1.5 to 2.75 inches (3.8 to 7 cm), depending on the size of the horse and the thickness of the triceps muscle. A relatively large volume of fluid can be aspirated from the caudal pouch of the elbow joint.

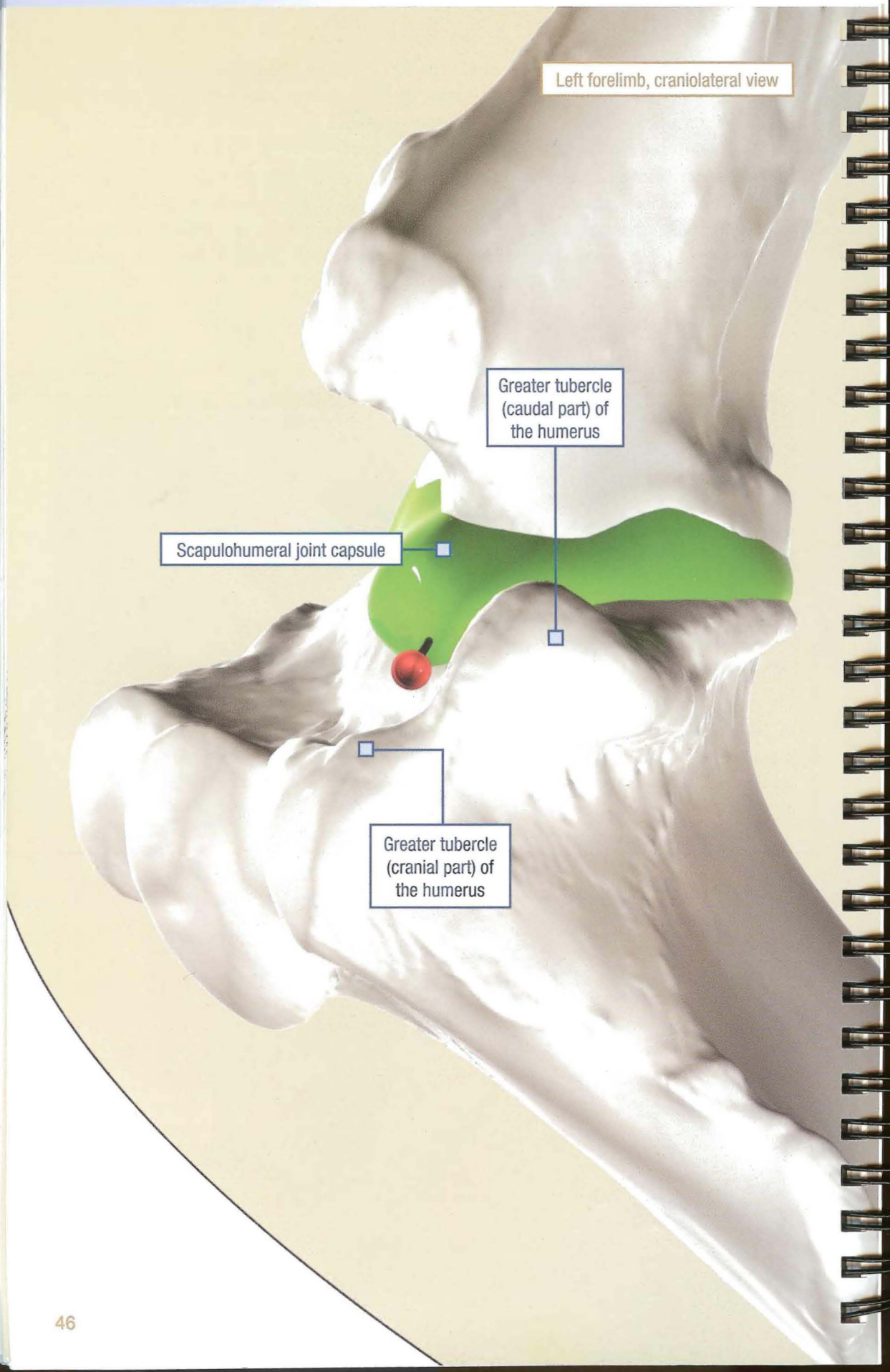


Palpate the distal end of the lateral supracondylar crest of the humerus and the proximal end of the ulna. *Note: The left forelimb is being palpated.*

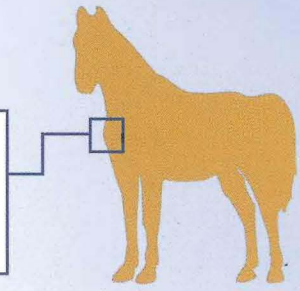
Insert the needle at a point 0.5 inch (1.3 cm) proximal to a line between the two points and one-third of the distance caudally along the line. *Note: Needle is in the left forelimb.*

SCAPULOHUMERAL JOINT

CRANIOLATERAL APPROACH



Needle: 3.5 to 5 in. (9 to 12.7 cm), 18 ga, spinal
Volume: 20 to 40 mL
Degree of difficulty: 3/3



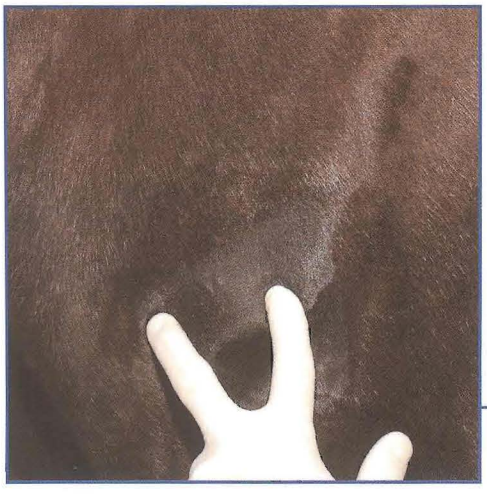
The **scapulohumeral joint** (shoulder joint) is difficult to enter because of its relative depth. The landmarks, however, are easily identified.

The point of the shoulder (greater tubercle) is large and divided into cranial and caudal parts. A notch can be palpated between the cranial and caudal parts, and this notch is where the needle is inserted. Direct the needle parallel to the ground and somewhat caudally, aiming toward the opposite elbow. The depth of penetration varies with the size of the horse, but it may be as deep as 4 to 5 inches (10 to 12.7 cm). Lack of resistance to pressure on the plunger of the syringe is not a good indication that the joint has been entered. The best indication that the joint has been entered successfully is the appearance of synovial fluid in the needle hub or the ability to aspirate synovial fluid or the injected contents of the syringe.

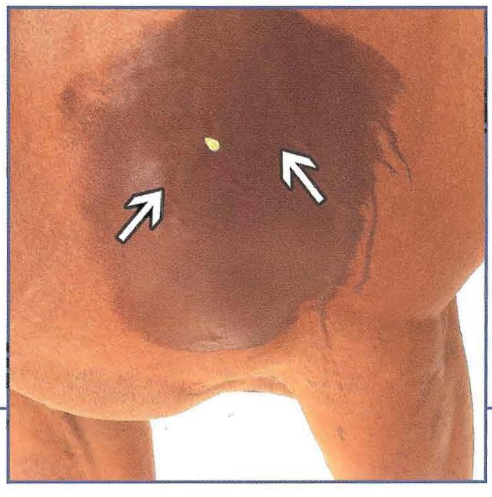
Flexible needles that bend easily should always be used when performing arthrocentesis of the shoulder joint to prevent the needle from breaking or damaging underlying tissue. Commonly, limb motion or muscle contraction may bend a positioned needle. The shoulder joint of some horses communicates with the bicipital bursa[53,54]; therefore, local anesthetic solution instilled into the shoulder joint of some horses can improve lameness associated with the bicipital bursa.

If a horse's behavior makes entering the joint difficult or impossible, sedation using xylazine hydrochloride, administered intravenously, may be helpful. Sedation with 0.2 to 0.4 mg/kg xylazine is unlikely to significantly alter the gait of a lame horse, but after 30 or 40 minutes, the effects of xylazine should no longer be apparent and, therefore, should not influence the horse's gait as it relates to the observation of lameness.

In some cases, inadvertent deposition of local anesthetic solution outside the shoulder joint may result in anesthesia of the radial nerve. For this reason we prefer to use lidocaine for this block because it provides a shorter duration of anesthesia.



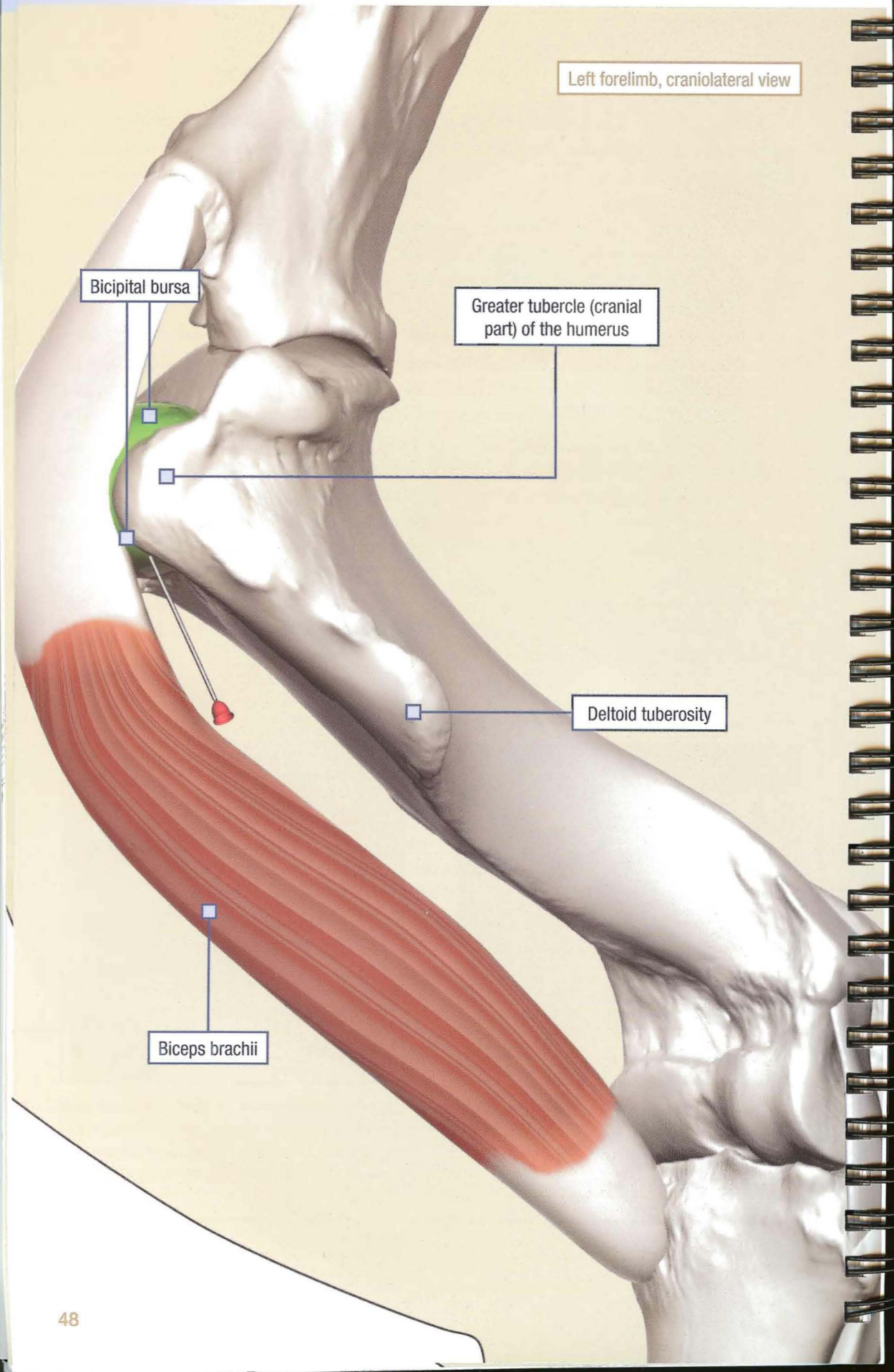
Palpate the cranial and caudal parts of the greater tubercle of the humerus. *Note: The left shoulder is shown.*



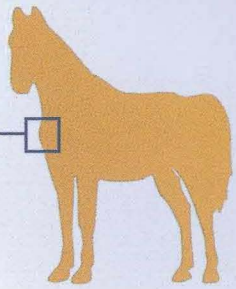
Insert the needle between the cranial and caudal parts (*arrows*) of the greater tubercle. Direct the needle somewhat caudally (toward the opposite elbow) with the shaft parallel to the ground. *Note: Needle is in the left forelimb.*

BICIPITAL BURSA

DISTAL APPROACH

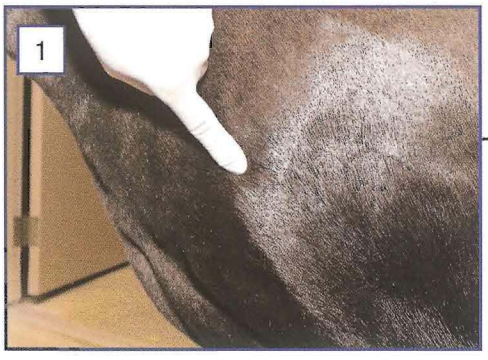


Needle: 3.5 to 5 in. (9 to 12.7 cm), 18 to 20 ga, spinal
Volume: 20 to 30 mL
Degree of difficulty: 3/3

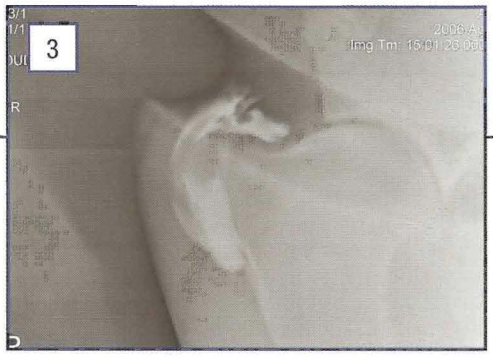


The **bicipital bursa** (intertuberal bursa) lies beneath the tendon of origin of the biceps brachii muscle as it passes through the intertuberal groove medial to the cranial part of the greater tubercle. To insert a needle into the bicipital bursa, introduce a 3.5- to 5-inch (9- to 12.7-cm), 18- to 20-gauge spinal needle at a point 2.5 inches (6.4 cm) distal and 3 inches (7.5 cm) caudal to the cranial part of the greater tubercle of the humerus. Direct the needle medially and proximally, aiming for the intertuberal groove, until it contacts bone. For a 1,000- to 1,400-lb (450- to 635-kg) horse, a 3.5-inch (9-cm) needle is usually inserted to its hub. Radiologic identification of radiopaque contrast medium, which can be injected with the anesthetic solution, within the bursa is evidence of a successful bursal injection.

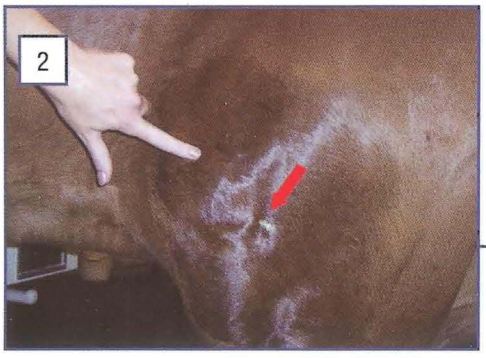
Another method of centesis of the bicipital bursa, described by Grant,[55] is to insert a 3.5-inch (9-cm), 18- to 20-gauge spinal needle 1.5 inches (3.8 cm) proximal to the distal aspect of the deltoid tuberosity and advance it dorsocranially for 2 to 3 inches (5 to 7.5 cm) (aiming for the bicipital groove and the opposite ear of the horse). Advance the needle until there is a distinct change in resistance. Synovial fluid can usually be aspirated. This technique of centesis is similar to that described by Lewis.[56] This technique may be more accurate when attempting centesis of the bicipital bursa of horses that are smaller or larger than the average-sized Quarter Horse or Thoroughbred.



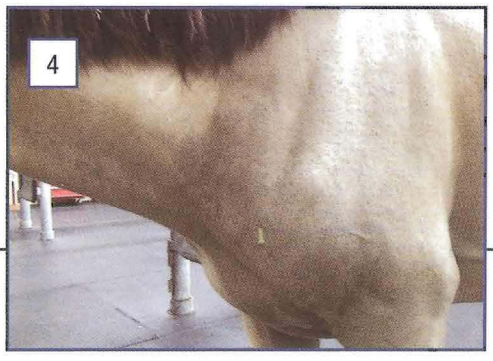
Palpate the cranial part of the greater tubercle. *Note: The left forelimb is shown.*



Radiologic identification of radiopaque contrast medium (which can be injected with the anesthetic solution) within the **bursa** is evidence of a successful bursal injection. *Note: Contrast solution is in the left forelimb.*



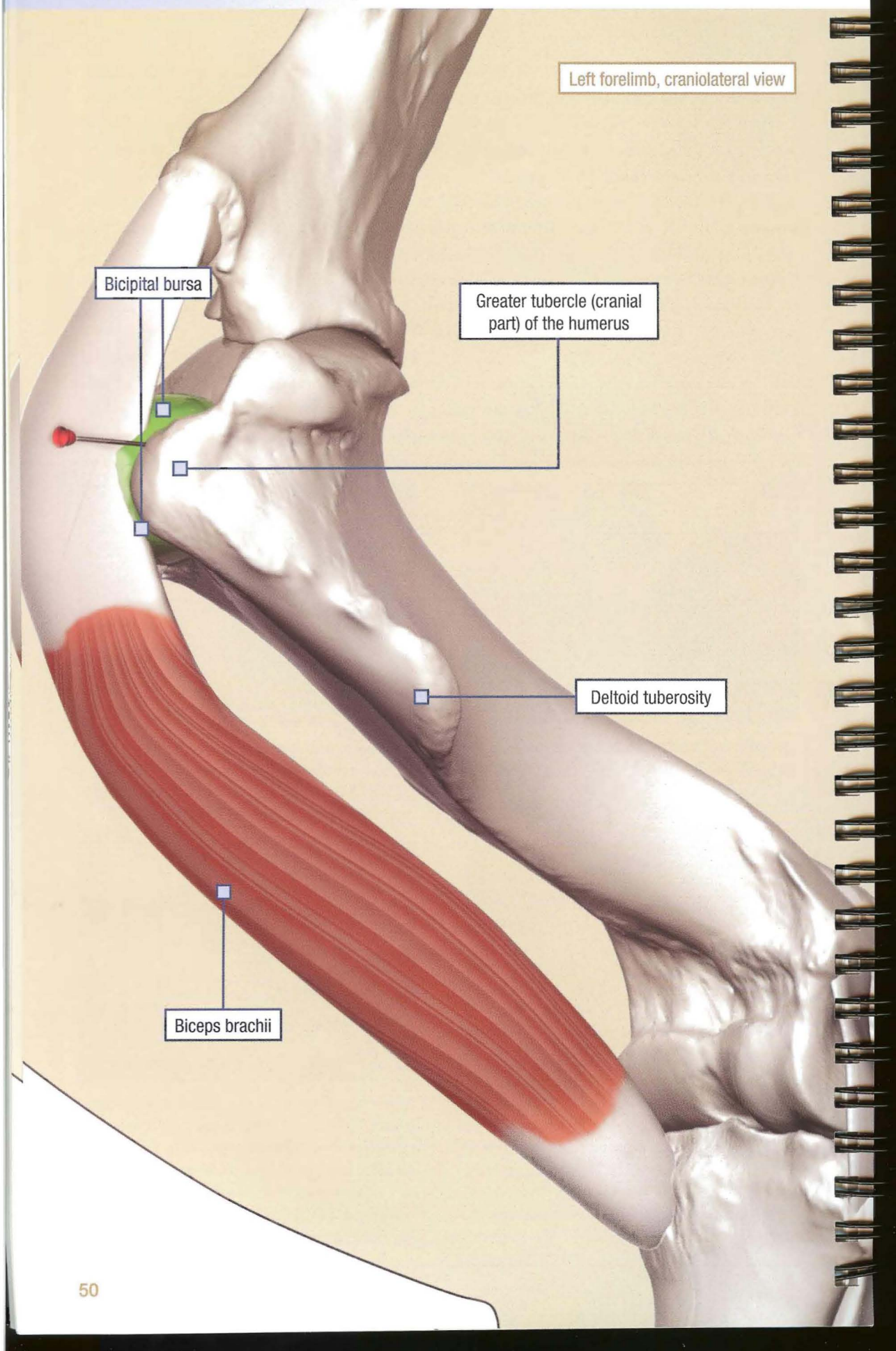
Insert the needle 2.5 inches (6.4 cm) distal and 3 inches (7.5 cm) caudal to this prominence, and direct the needle medially and proximally, beneath the bicipital tendon, until it contacts bone. A finger is pointed at the cranial part of the greater tubercle of the humerus. The *arrow* indicates the site of needle insertion. *Note: Needle is in the left forelimb.*



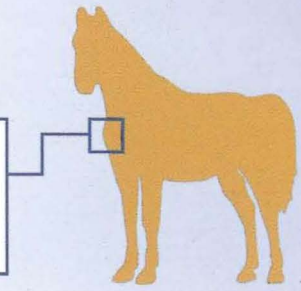
Another method of centesis of the **bicipital bursa**, described by Grant,[55] is to insert a 3.5-inch (9-cm), 18- to 20-gauge spinal needle 1.5 inches (3.8 cm) proximal to the distal aspect of the deltoid tuberosity. The needle is advanced dorsocranially for 2 to 3 inches (5 to 7.5 cm) (aiming for the bicipital groove) until there is a distinct change in resistance. Synovial fluid can usually be aspirated. *Note: Needle is in the left forelimb.*

BICIPITAL BURSA

PROXIMAL APPROACH



Needle: 1.5 in. (3.8 cm), 20 ga
Volume: 20 to 30 mL
Degree of difficulty: 2/3

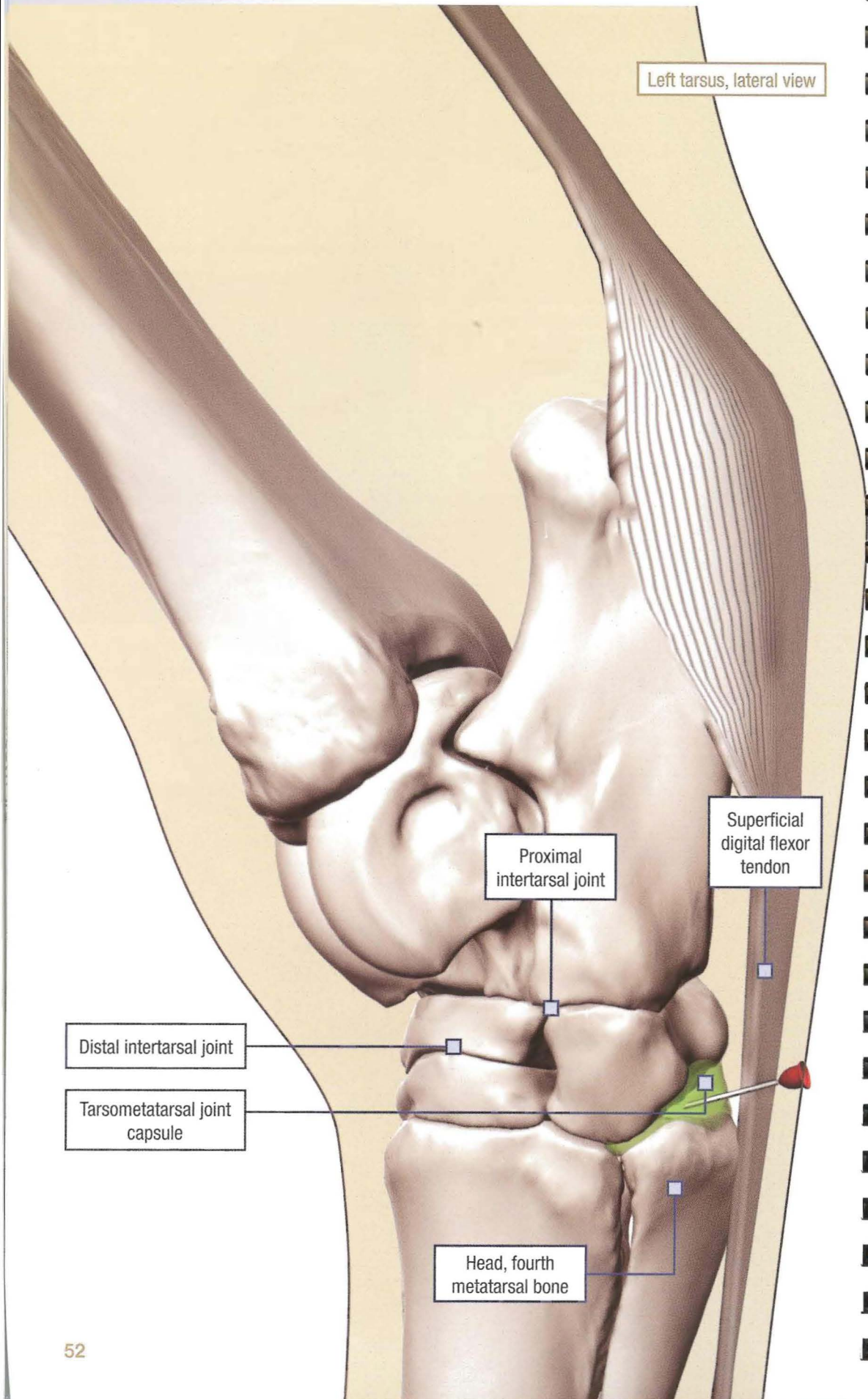


To insert a needle into the **bicipital bursa**, introduce a 1.5-inch (3.8-cm), 20-gauge needle into the bicipital groove, which can be palpated medial to the edge of the cranial part of the greater tubercle of the humerus. With the limb either bearing weight or held, insert the needle into the groove in a plane parallel to the bearing surface of the foot at an angle of approximately 45° to the sagittal axis of the horse until the needle is felt to strike cartilage. Slightly retract the needle before injecting local anesthetic solution.

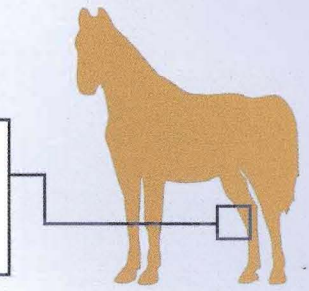
With the limb either bearing weight or held, insert the needle into the bicipital groove in a plane parallel to the bearing surface of the foot at a 45° angle to the sagittal axis of the horse until the needle is felt to strike cartilage. Slightly retract the needle before injecting local anesthetic solution. A finger is pointed at the cranial part of the greater tubercle of the humerus. *Note: Needle is in the left forelimb.*

TARSOMETATARSAL JOINT

PLANTAROLATERAL APPROACH



Needle: 1.5 in. (3.8 cm), 19 to 20 ga
Volume: 3 to 5 mL
Degree of difficulty: 1/3



The **tibiotarsal (tarsocrural), proximal intertarsal (talocalcaneocentral), distal intertarsal (centrodistal), and tarsometatarsal joints** are the four joints that compose the hock. Because the hock is a common site of pain causing lameness, arthrocentesis is common for both diagnosis and treatment. The tibiotarsal and proximal intertarsal joints communicate directly, but how commonly the distal intertarsal joint communicates directly with the tarsometatarsal joint is controversial.[57-59]

The **tarsometatarsal joint** is entered most easily when the joint is approached from the caudolateral aspect of the hock. The palpable landmarks are the head of the fourth metatarsal bone (i.e., the lateral splint bone) and the lateral edge of the superficial digital flexor tendon.

Insert the needle about 0.25 inch (0.6 cm) above the head of the lateral splint bone and 0.5 inch (1.3 cm) lateral to the lateral edge of the superficial digital flexor tendon. Direct the needle toward the dorsomedial aspect of the hock and slightly distally to a depth of 0.5 to 1 inch (1.3 to 2.5 cm). The joint is usually entered with the limb bearing weight, but it can be entered with the limb being held when dealing with known "kickers." The technique for needle placement is the same. Generally, the first 3 to 5 mL of anesthetic solution is easily injected. Forcing more into the joint is thought by some to cause the anesthetic solution to enter the distal intertarsal joint,[58,59] but arthrographic studies show that injecting fluid into the tarsometatarsal joint under pressure causes the fluid to accumulate subcutaneously rather than in the distal intertarsal joint.[60]

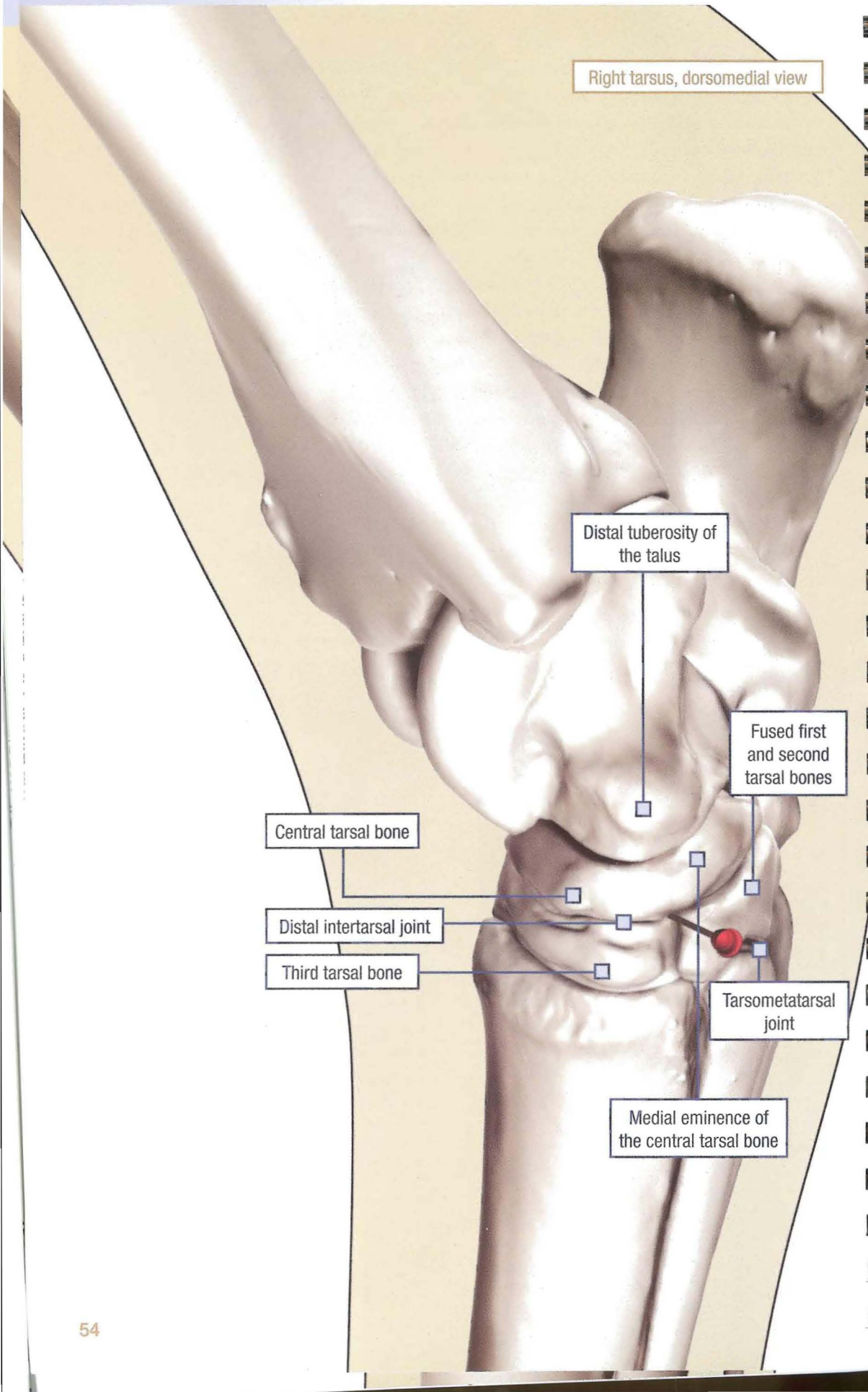
Local anesthetic solution injected into the tarsometatarsal joint may result in perineural analgesia of the dorsal metatarsal and plantar metatarsal nerves, which are often desensitized using regional nerve blocks to diagnosis disease of the proximal portion of the suspensory ligament.[10]

Palpate the proximal edge of the head of the fourth metatarsal bone. *Note: The left hindlimb is being palpated.*

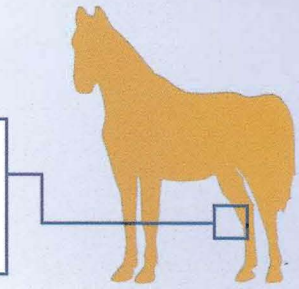
Insert the needle just proximal to the proximal edge of the head of the fourth metatarsal bone. Direct the needle slightly distally and toward the dorsomedial aspect of the hock. *Note: Needle is in the left tarsometatarsal joint.*

DISTAL INTERTARSAL (CENTRODISTAL) JOINT

MEDIAL APPROACH



Needle: 5/8 to 1 in. (1.6 to 2.5 cm), 23 to 25 ga
Volume: 3 to 5 mL
Degree of difficulty: 2/3

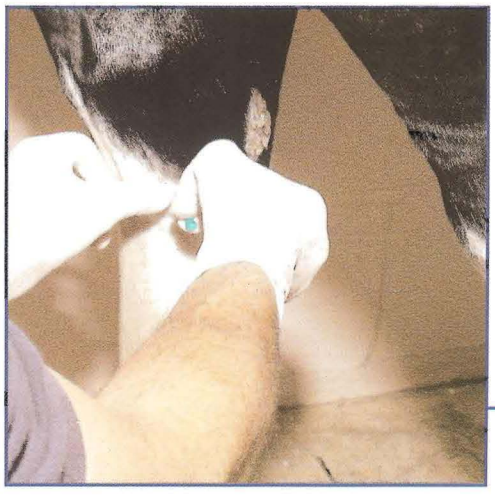


Arthrocentesis of the **distal intertarsal joint** (centrodistal joint) is technically more difficult than arthrocentesis of the tarsometatarsal joint, and its medial approach presents more danger to the clinician. The distal intertarsal joint is entered on the distomedial aspect of the hock, midway between the plantar and dorsal aspects of the distal portion of the tarsus, with the limb bearing weight. The site of arthrocentesis can be found by first identifying the easily palpated distal tuberosity of the talus. Distal and plantar to this tuberosity is a less discernible medial eminence of the central tarsal bone. The site for needle insertion is halfway between these landmarks and 0.5 inch (1.3 cm) distal to the eminence of the central tarsal bone.

Insert a 5/8- to 1-inch (1.6- to 2.5-cm), 23- to 25-gauge needle into the proximal part of the small, T-shaped gap formed by the junction of the fused first and second tarsal bones, the third tarsal bone, and the central tarsal bone. This gap can usually be palpated using a fingernail. The needle should be inserted as proximally as possible in this gap to avoid entering the tarsometatarsal joint, which occupies the distal portion of the gap.[61] The site may be difficult to find, especially if the joint has severe degenerative disease. The needle is determined to be within the distal intertarsal joint by low resistance to injection without development of subcutaneous swelling and the ability to aspirate the injected contents of the syringe. The distal intertarsal joint frequently communicates with the cunean bursa.[28]

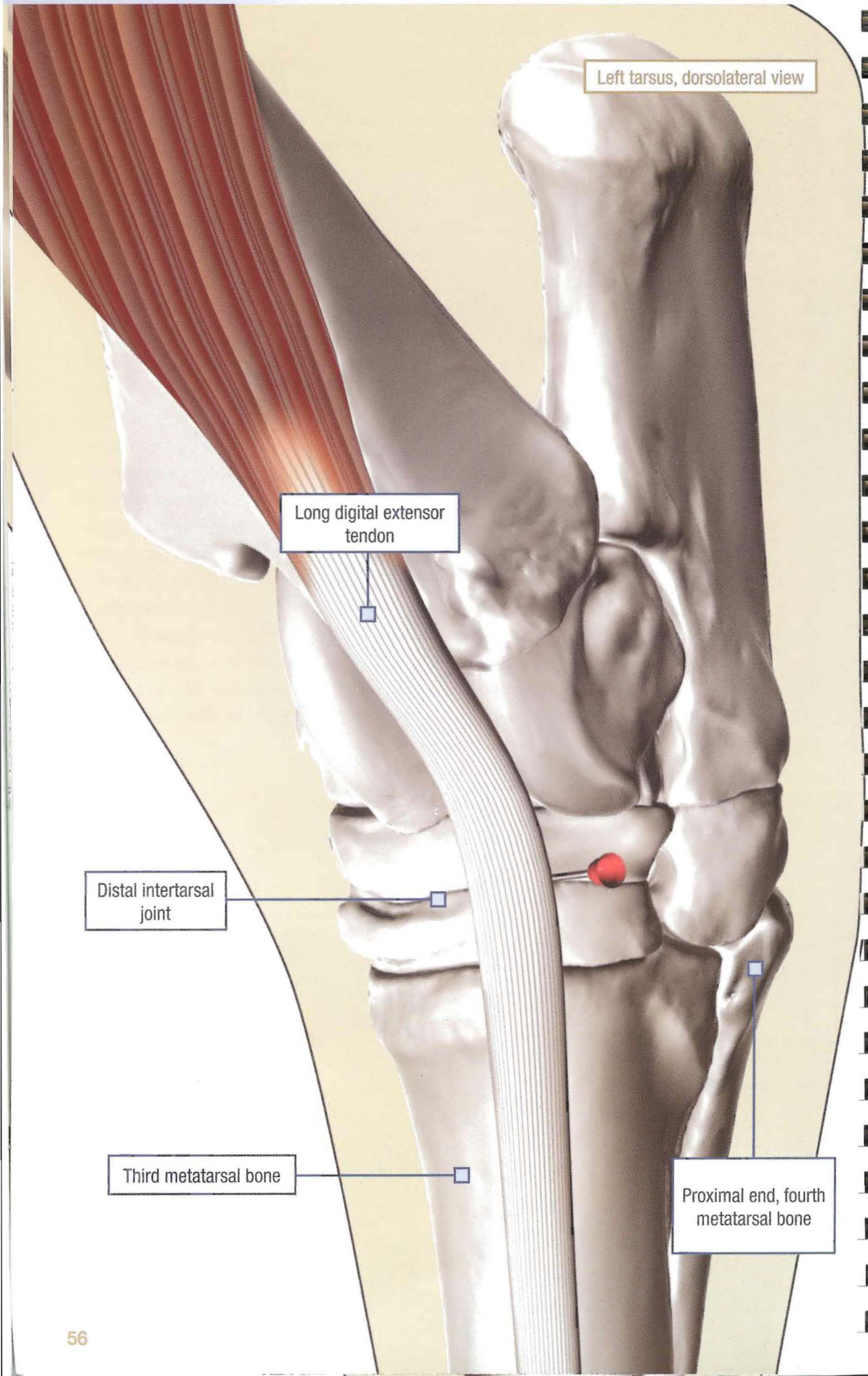
Anesthesia of the tarsometatarsal joint is often assumed to cause anesthesia of the distal intertarsal joint, and, consequently, some clinicians attempt to either block or treat both distal joints of the hock simultaneously by injecting only the tarsometatarsal joint. Results of trials investigating the frequency of direct communication between the tarsometatarsal and distal intertarsal joints show that these two joints communicate directly in approximately 25% of tarsi.[60–62] Results of a study by Gough et al[63] indicate that anesthesia of the distal intertarsal joint may be unnecessary if the tarsometatarsal joint has been anesthetized, even if the joints do not communicate directly, because an effective concentration of local anesthetic solution diffuses into the distal intertarsal joint after injection of the tarsometatarsal joint. Serena et al[64] showed that a therapeutic concentration of methylprednisolone acetate is also able to diffuse from the tarsometatarsal joint into the distal intertarsal joint. Whether this is true for other corticosteroids has not been determined.

Insert the needle into the **distal intertarsal joint**, midway between the plantar and dorsal aspects of the distal portion of the tarsus. Insert the needle below the distal edge of the cunean tendon into the T-shaped gap formed by the junction of the fused first and second tarsal bones, the third tarsal bone, and the central tarsal bone. *Note: Needle is in the right hindlimb.*

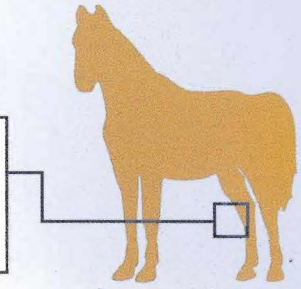


DISTAL INTERTARSAL (CENTRODISTAL) JOINT

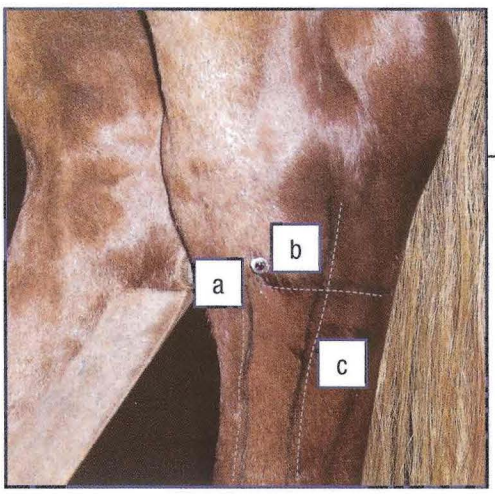
DORSOLATERAL APPROACH



Needle: 1.5 in. (3.8 cm), 20 to 22 ga
Volume: 3 to 5 mL
Degree of difficulty: 2/3



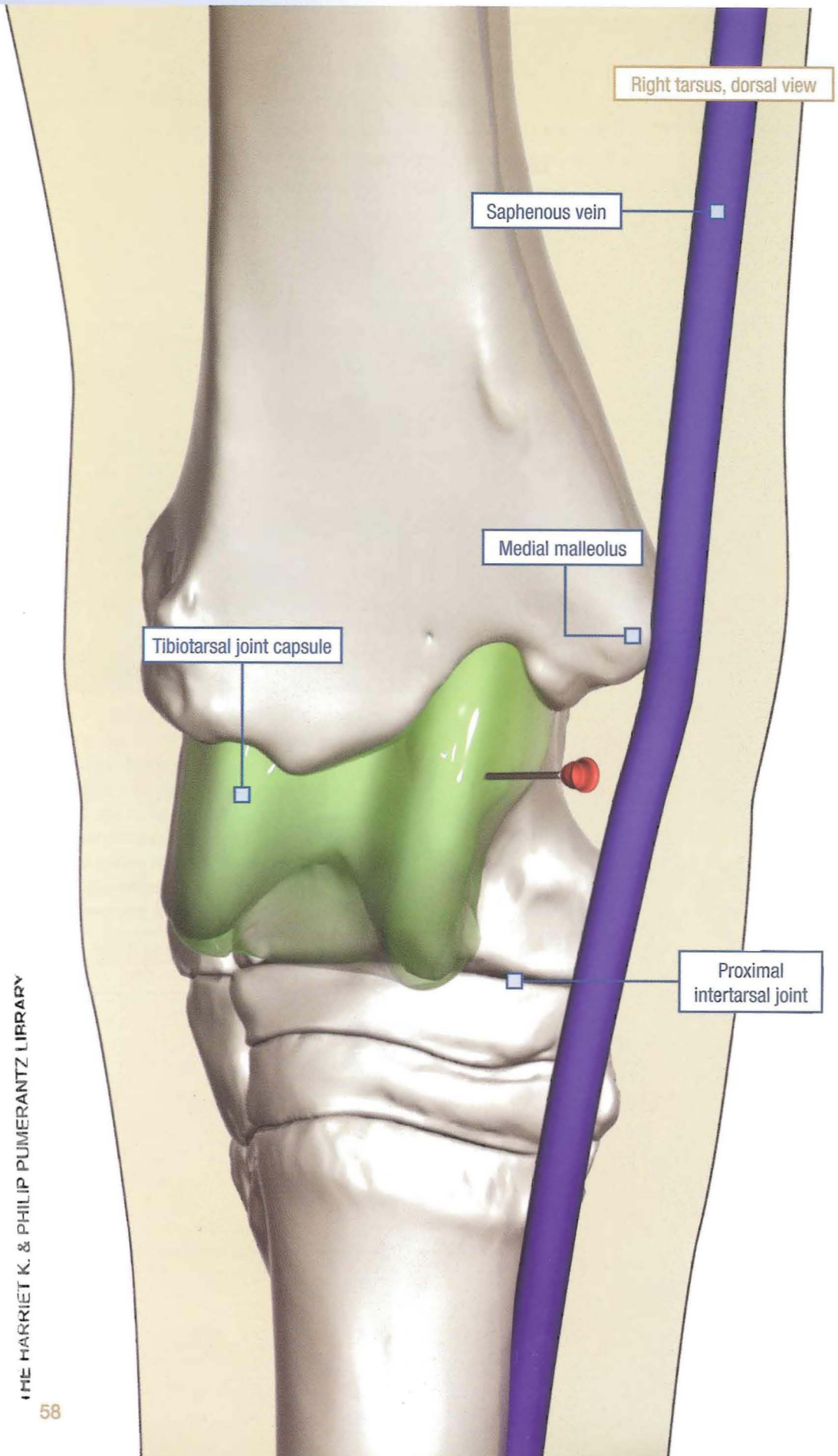
Because the medial approach to the **distal intertarsal joint** (centrodistal joint) places the clinician in a vulnerable position for injury, some clinicians prefer a dorsolateral approach to this joint. As described by Just et al,[65] the injection site is 2 to 3 mm lateral to the long digital extensor tendon and 6 to 8 mm proximal to a line drawn perpendicular to the axis of the third metatarsal bone through the proximal end of the fourth metatarsal bone. The needle is directed plantaromedially at an angle of approximately 70° from the sagittal plane. Sedating the horse and using a nose twitch increases the safety of the procedure.



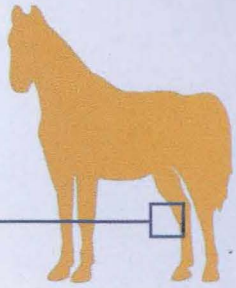
The injection site for the **distal intertarsal joint** is 2 to 3 mm lateral to the long digital extensor tendon (a) (most dorsal blue dotted line identifies the plantar edge of this tendon) and 6 to 8 mm proximal to (b) a line drawn perpendicular to the axis of the third metatarsal bone through the (c) proximal end of the fourth metatarsal bone. The needle is directed plantaromedially at an angle of approximately 70° from the sagittal plane. Identifying the landmarks with a marker pen facilitates the procedure. *Note: Needle is in the left hindlimb.*

TIBIOTARSAL JOINT

DORSAL APPROACH



Needle: 1 in. (2.5 cm), 20 ga
Volume: 10 to 20 mL
Degree of difficulty: 1/3



The **tibiotarsal joint** (tarsocrural joint) is the easiest of all joints to inject. The joint capsule is thin and superficial, and the landmarks are obvious and discernible.

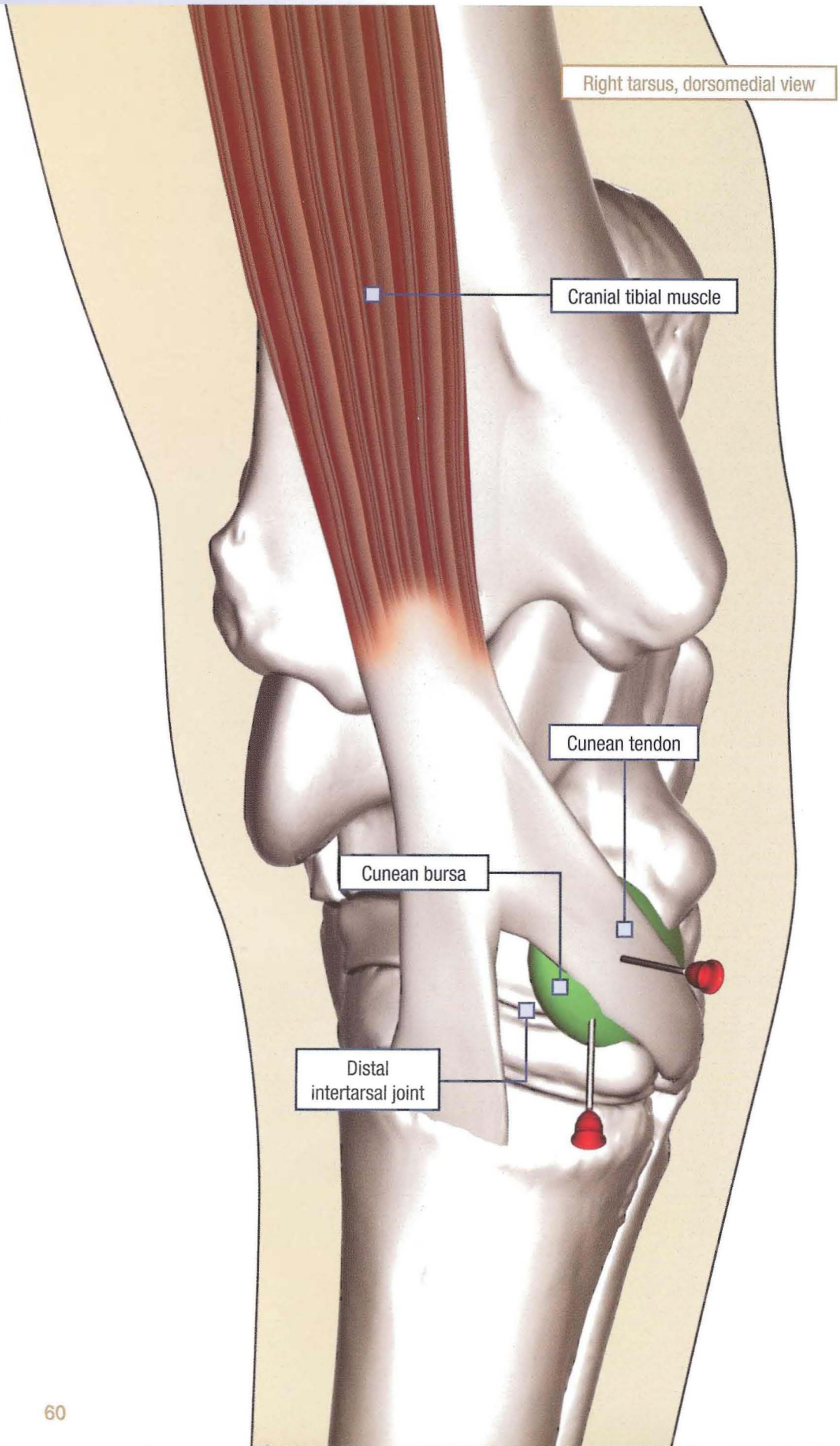
The joint can be penetrated on either the medial or lateral side of the saphenous vein as it vertically traverses the joint, approximately 1 to 1.5 inches (2.5 to 3.8 cm) distal to the level of the prominent medial malleolus at the distal end of the tibia. The depth of penetration is seldom more than 0.5 inch (1.3 cm). When the tibiotarsal joint is distended by effusion, the medial and lateral plantar synovial pouches are readily discernible, and arthrocentesis at either of these sites is easily accomplished. The tibiotarsal joint communicates directly with the proximal intertarsal joint.

Palpate the **tibiotarsal joint** distal to the level of the medial malleolus of the tibia. *Note: The right hindlimb is being palpated.*

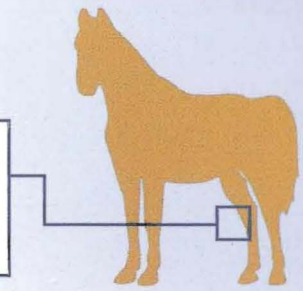
Insert the needle just medial or lateral to the visible saphenous vein, 1 to 1.5 inches (2.5 to 3.8 cm) distal to the level of the palpable medial malleolus. The joint capsule is superficial and thin. *Note: Needle is in the right hindlimb.*

CUNEAN BURSA

MEDIAL APPROACH

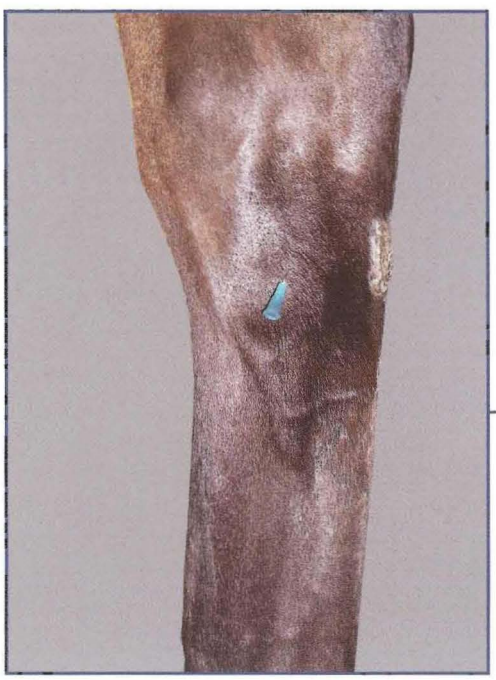


Needle: 1 in. (2.5 cm), 20 to 21 ga
Volume: 3 to 4 mL
Degree of difficulty: 2/3



The **cunean bursa** is occasionally injected with local anesthetic solution for the diagnosis of bursitis of that structure as a cause of lameness or with a corticosteroid as a treatment for lameness caused by bursitis of that structure. However, the validity of cunean bursitis as a cause of lameness is questionable. The cunean bursa occasionally communicates with the distal intertarsal joint (centrodistal joint),[63] which may explain why administration of local anesthetic solution or a corticosteroid into the cunean bursa can temporarily resolve or ameliorate lameness in a horse whose lameness is caused by degenerative joint disease.

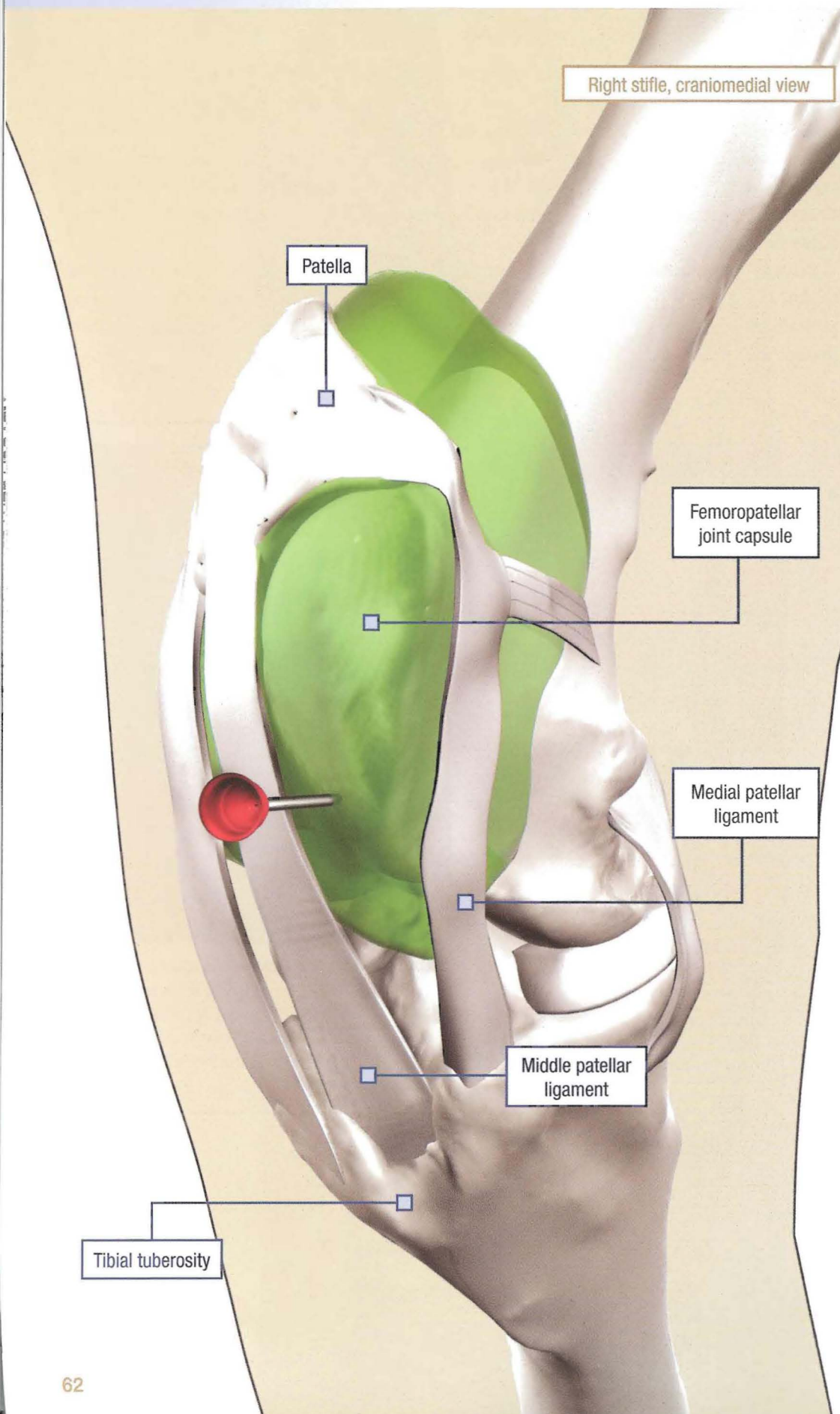
Centesis of the cunean bursa is accomplished by inserting a needle at the distal edge of the cunean tendon and directing the needle proximally beneath the tendon, which travels in a proximodorsal, plantarodistal direction on the medial aspect of the hock. The needle can also be inserted directly distal through the tendon into the bursa.



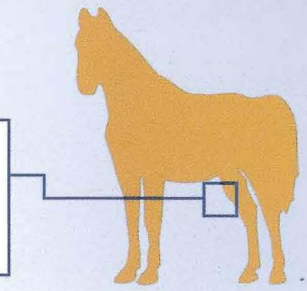
Centesis of the **cunean bursa** is accomplished by inserting a needle at the distal edge of the cunean tendon and directing the needle proximally beneath the cunean tendon, which travels in a proximodorsal, plantarodistal direction on the medial aspect of the hock. *Note: Needle is in the right hindlimb.*

FEMOROPATELLAR JOINT

CRANIAL APPROACH



Needle: 1.5 to 3 in. (3.8 to 7.5 cm), 18 to 20 ga
Volume: 20+ mL
Degree of difficulty: 2 to 3/3



The **stifle** is a large and complex structure consisting of two joints, the **femoropatellar** and the **femorotibial**. The **femorotibial joint** is composed of the lateral femorotibial and medial femorotibial compartments. Intraarticular anesthesia is often required to diagnose stifle problems; therefore, the techniques for injecting the compartments of the stifle joints are important. With some horses, difficulty in locating the anatomic landmarks can be reduced by clipping the hair or palpating the structures with the limb flexed. Standing the horse squarely can facilitate palpation of the medial and lateral patellar ligaments.

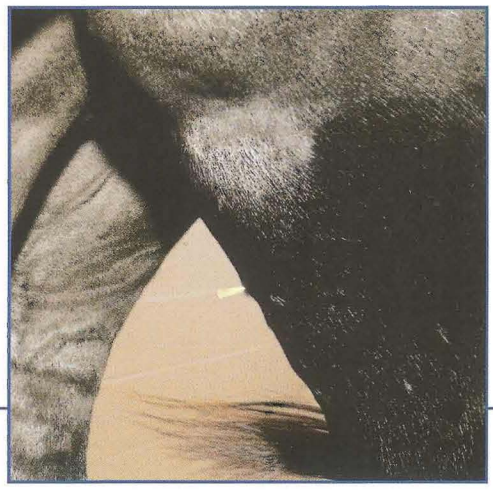
Results of a study by Gough et al[63] show a greater diffusion of local anesthetic solution between compartments of the stifle than previously assumed from results of anatomic, latex-injection, and contrast arthrographic studies. Blocking a specific compartment of the stifle may produce anesthesia of the other two compartments not blocked directly.

The **femoropatellar joint** is the largest of the three compartments of the stifle. It communicates directly with the medial compartment of the femorotibial joint in about 65% of horses,[66] but it seldom communicates directly with the lateral compartment. The joint can be difficult to enter and is, we believe, the compartment of the stifle that horses most resent having penetrated.

The landmarks that are easiest to locate are the proximal aspect of the tibial tuberosity, the patellar ligaments, and the patella. The most uniformly successful technique of insertion is to direct the needle 1 to 1.5 inches (2.5 to 3.8 cm) above the palpable proximal aspect of the tibial tuberosity, between the middle and medial patellar ligaments. Direct the needle parallel to the ground.

Obstacles that may prevent needle entry are the large fat pad between the patellar ligaments and joint capsule and limb motion during penetration. The procedure can be carried out with the limb either bearing weight or flexed,[66] but performing the procedure with the limb flexed requires an additional assistant. The recommended volume of local anesthetic solution for injection varies from as little as 10 mL[42] to as much as 100 mL.

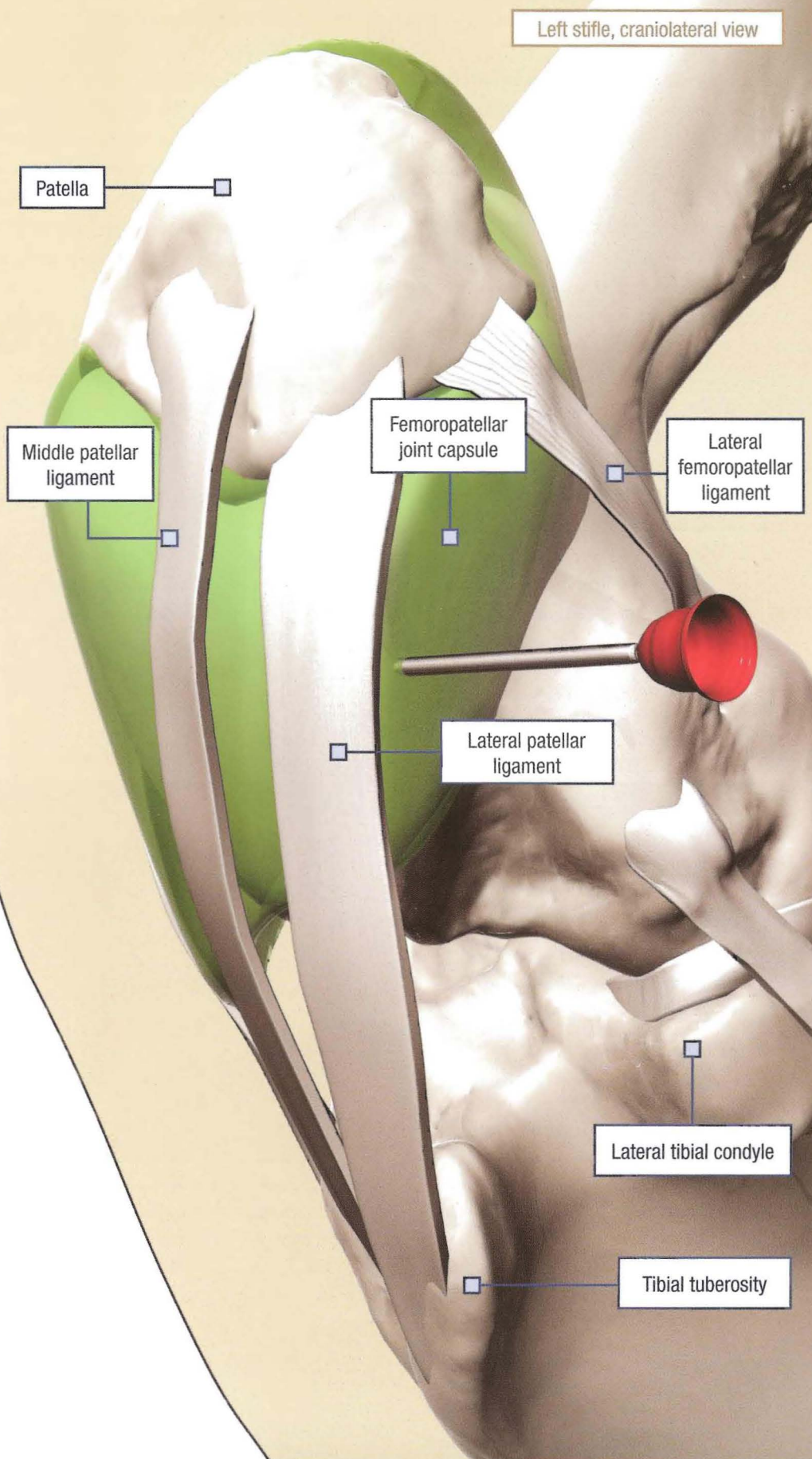
Palpate the tibial tuberosity and the middle and medial patellar ligaments. *Note: The left hindlimb is being palpated.*



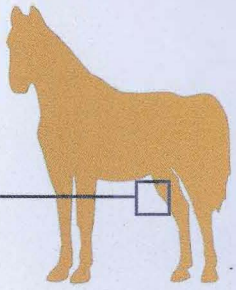
Insert the needle 1.5 inches (3.8 cm) proximal to the tibial tuberosity between the middle and medial patellar ligaments. *Note: Needle is in the left hindlimb.*

FEMOROPATELLAR JOINT

LATERAL APPROACH



Needle: 1.5 in. (3.8 cm), 18 to 20 ga
Volume: 20+ mL
Degree of difficulty: 2/3



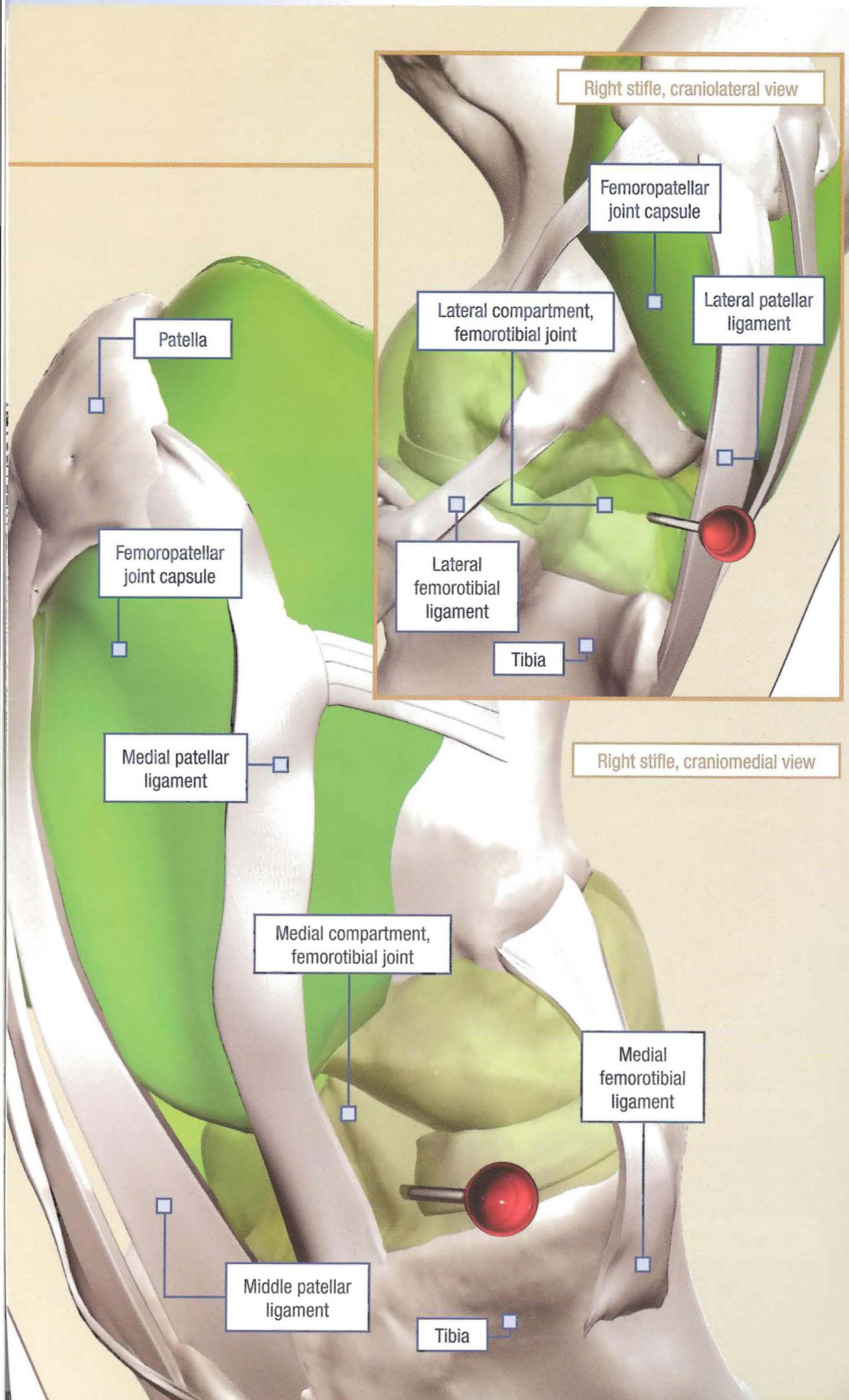
An alternate approach to the **femoropatellar joint**, described by Hendrickson and Nixon,[67] is to insert the needle into the lateral cul-de-sac of the joint. Direct a 1.5-inch (3.8-cm), 18- to 20-gauge needle perpendicular to the long axis of the limb, approximately 2 inches (5 cm) above the palpable lateral edge of the lateral tibial condyle, just behind the caudal edge of the palpable lateral patellar ligament. Insert the needle until bone is contacted, and then slightly withdraw it. Synovial fluid can usually be aspirated.

Palpate the lateral edge of the lateral tibial condyle. *Note: The left hindlimb is being palpated.*

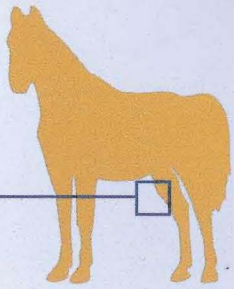
Insert the needle perpendicular to the long axis of the limb, about 2 inches (5 cm) above the lateral edge of the lateral tibial condyle and just behind the caudal edge of the palpable lateral patellar ligament, until bone is contacted; then slightly withdraw the needle. *Note: Needle is in the left hindlimb.*

FEMOROTIBIAL JOINT

LATERAL AND MEDIAL APPROACHES

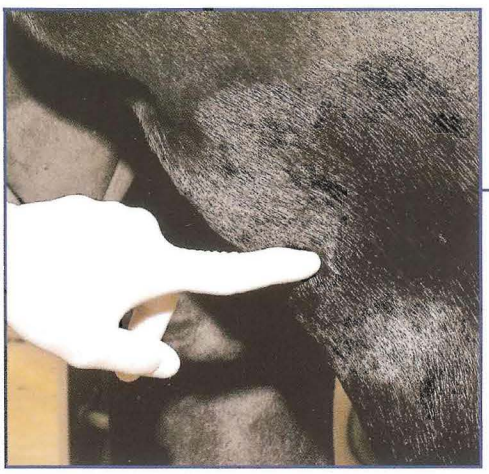


Needle: 1.5 in. (3.8 cm), 18 to 20 ga
Volume: 20 to 30 mL
Degree of difficulty: 2/3

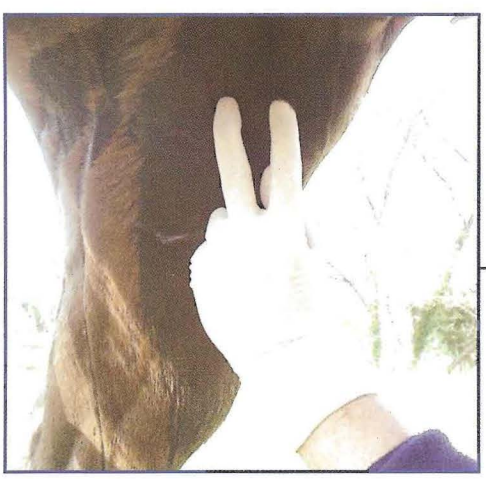


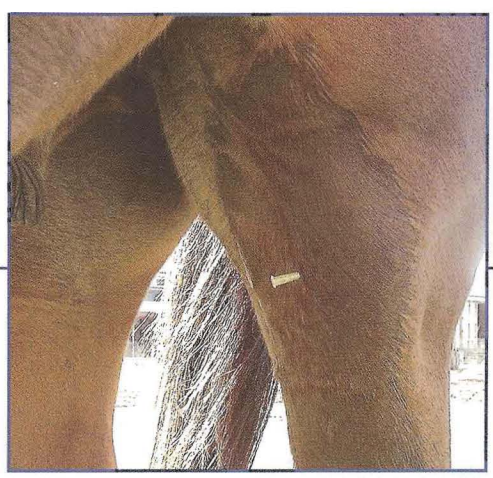
The **lateral compartment of the femorotibial joint** can be entered in two ways. We prefer the method that involves inserting the needle slightly caudal to the palpable lateral patellar ligament, just above the proximolateral edge of the tibia. Depth of penetration is generally about 1 inch (2.5 cm). The alternative technique is to enter through the space between the lateral femorotibial ligament and the origin of the long digital extensor muscle. The palpable head of the fibula helps to identify these structures. The depth of penetration is usually 0.75 to 1 inch (1.9 to 2.5 cm).

The **medial compartment of the femorotibial joint** is not difficult to enter, and because this compartment communicates with the femoropatellar joint in the majority of horses,[66–68] some clinicians choose to inject it rather than the femoropatellar joint in an attempt to either block or treat both this compartment and the femoropatellar joint. The injection site is located between the medial patellar ligament and the medial femorotibial ligament just above the palpable proximomedial edge of the tibia. The penetration depth is usually 0.75 to 1 inch (1.9 to 2.5 cm).



Palpate the **lateral patellar ligament** (*left*). The **lateral femorotibial ligament** is caudal to the lateral patellar ligament. Insert the needle behind the lateral patellar ligament, just above the proximolateral edge of the tibia (*right*). *Note: Needle is in the left hindlimb.*

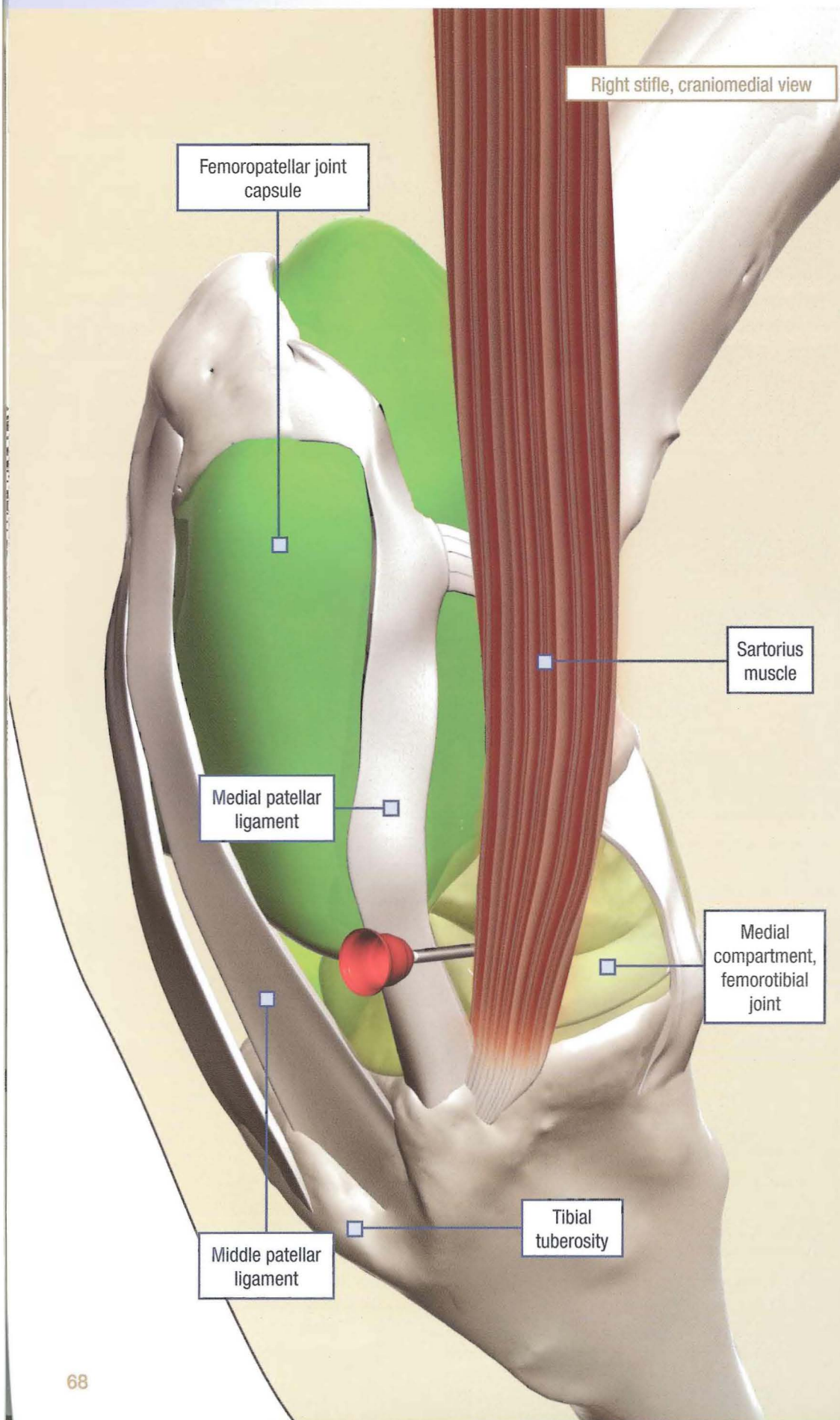




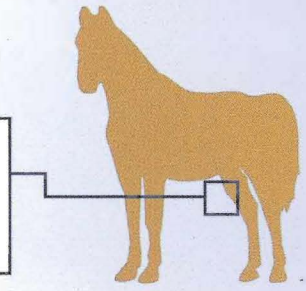
Palpate the **medial patellar ligament** and the **medial femorotibial ligament** (*left*). Insert the needle between the palpable medial patellar ligament and the medial femorotibial ligament, just proximal to the proximomedial edge of the tibia (*right*). *Note: Needle is in the left hindlimb.*

FEMOROTIBIAL JOINT

MEDIAL COMPARTMENT, MEDIAL OUTPOUCHING

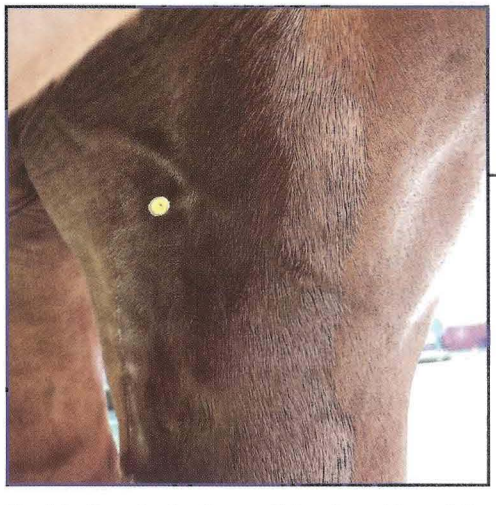


Needle: 1.5 in. (3.8 cm), 18 to 20 ga
Volume: 20 to 30 mL
Degree of difficulty: 2/3



An alternate approach to the **medial compartment of the femorotibial joint** was described by Swiderski et al.[69] Advantages of this technique include consistent recovery of synovial fluid and superior accuracy. Because the needle is not directed toward the medial meniscus or articular cartilage, painful reactions to arthrocentesis are less likely than with other techniques for arthrocentesis of this compartment.

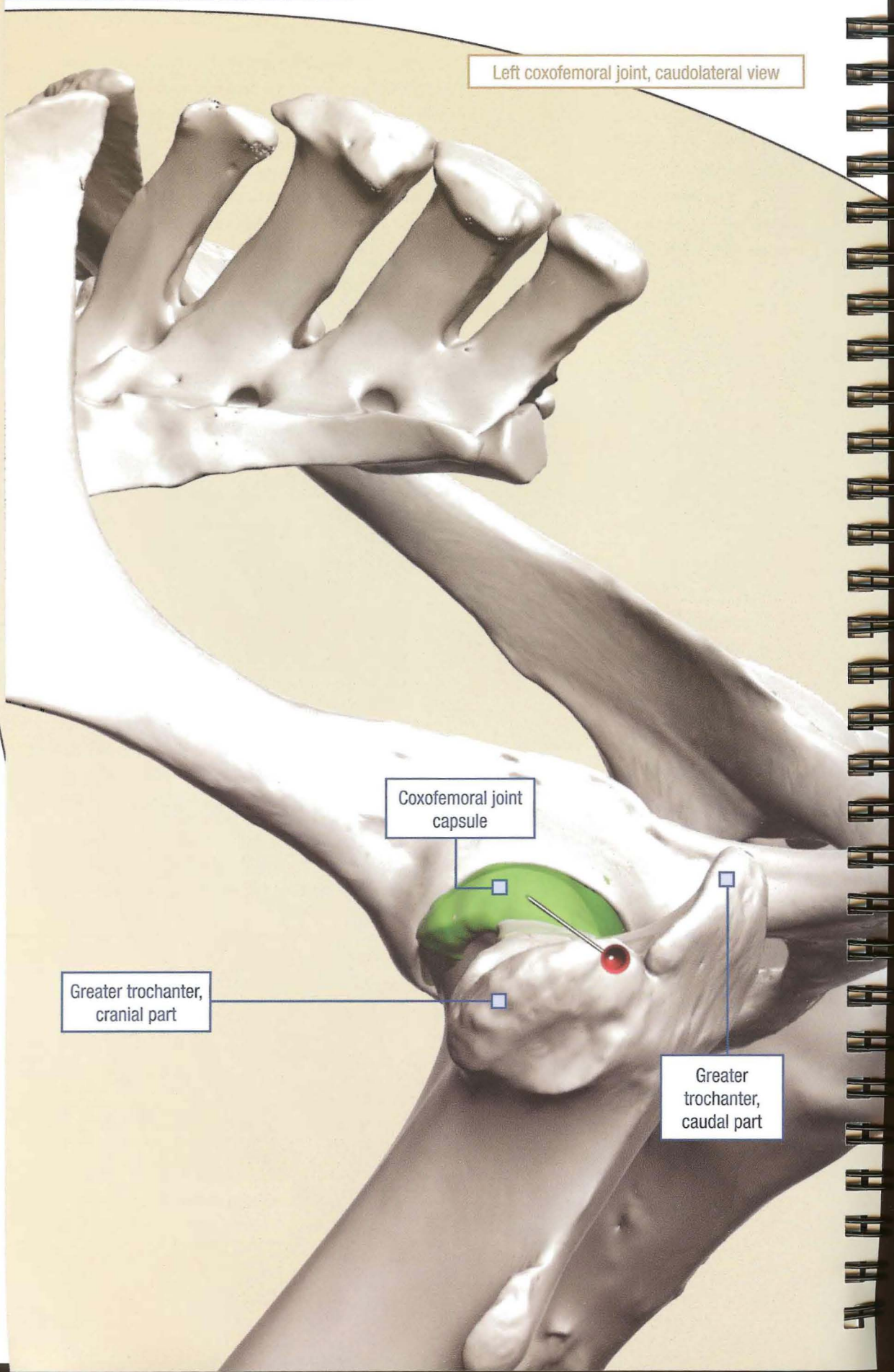
The injection site is an indentation between the medial patellar ligament and the tendon of the sartorius muscle about 1 inch (2.5 cm) above the tibial plateau (the dorsal surface of the tibia). The needle is advanced in a cranial to caudal direction parallel to the ground and parallel to a plane that bisects the limb longitudinally. Penetration depth is generally about 1 inch (2.5 cm).



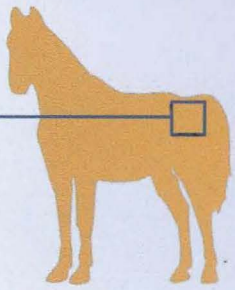
The injection site for the **medial outpouching of the medial compartment of the femorotibial joint** is an indentation between the medial patellar ligament and the tendon of the sartorius muscle, about 1 inch (2.5 cm) above the tibial plateau. Advance the needle in a cranial to caudal direction parallel to the ground and parallel to a plane that bisects the limb longitudinally. *Note: Needle is in the left hindlimb.*

COXOFEMORAL JOINT

CAUDOLATERAL TO CRANIOMEDIAL APPROACH



Needle: 3.5 to 6 in. (9 to 15 cm), 18 ga, spinal
Volume: Approximately 40 to 60 mL
Degree of difficulty: 3/3



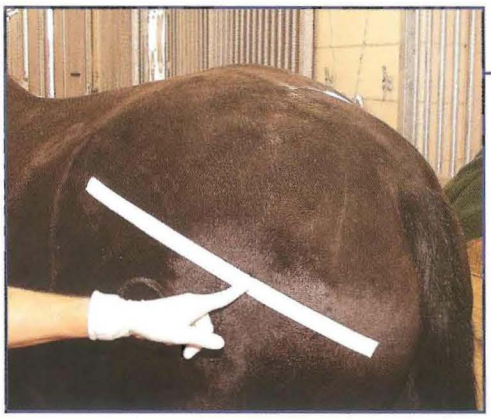
The **coxofemoral joint** of the pelvis is the most difficult joint to enter. It is located deep beneath heavy muscle and situated well away from the lateral aspect of the proximal end of the femur. The landmarks are difficult to identify. The first procedure described here is a variation of previously described methods.[40-42]

The important landmarks to palpate are the cranial and caudal parts of the greater trochanter of the femur. They are located (measured from cranioproximal to caudodistal) two-thirds of the distance between the palpable tuber coxae and the ischiatic tuberosity. The greater trochanter is approximately 4 inches (10 cm) wide, and there is a notch between the cranial and caudal parts of this structure. In our experience, this notch is generally not palpable.

Insert a spinal needle, equipped with its stylet, about 0.5 inch (1.3 cm) above the middle of the cranial part of the greater trochanter. The skin is thick in this area, and penetration may require more force than is needed when inserting a needle elsewhere on the horse. A stab incision, made with a #11 or #15 scalpel blade, may aid insertion. Needle insertion usually requires holding the shaft of the needle close to its tip. Direct the point slightly downward so that after the needle has been inserted to a depth of about 3 to 4 inches (7.5 to 10 cm), the point of the needle is about 0.5 inch (1.3 cm) lower than the point of entry. Direct the needle in a craniomedial direction.

If the needle does not enter the joint, withdraw it to within 0.5 inch (1.3 cm) or less of the skin before correcting the insertion angle. Redirect the needle without repenetrating the skin because horses often resent repenetration and become uncooperative.

Alternatively, place a 1.5- to 2-inch (3.8- to 5-cm), 14-gauge, disposable needle at the correct angle of penetration. Then insert the longer 18-gauge needle through the wider-bore needle. This is particularly useful for entering the coxofemoral joint of large, well-muscled horses.



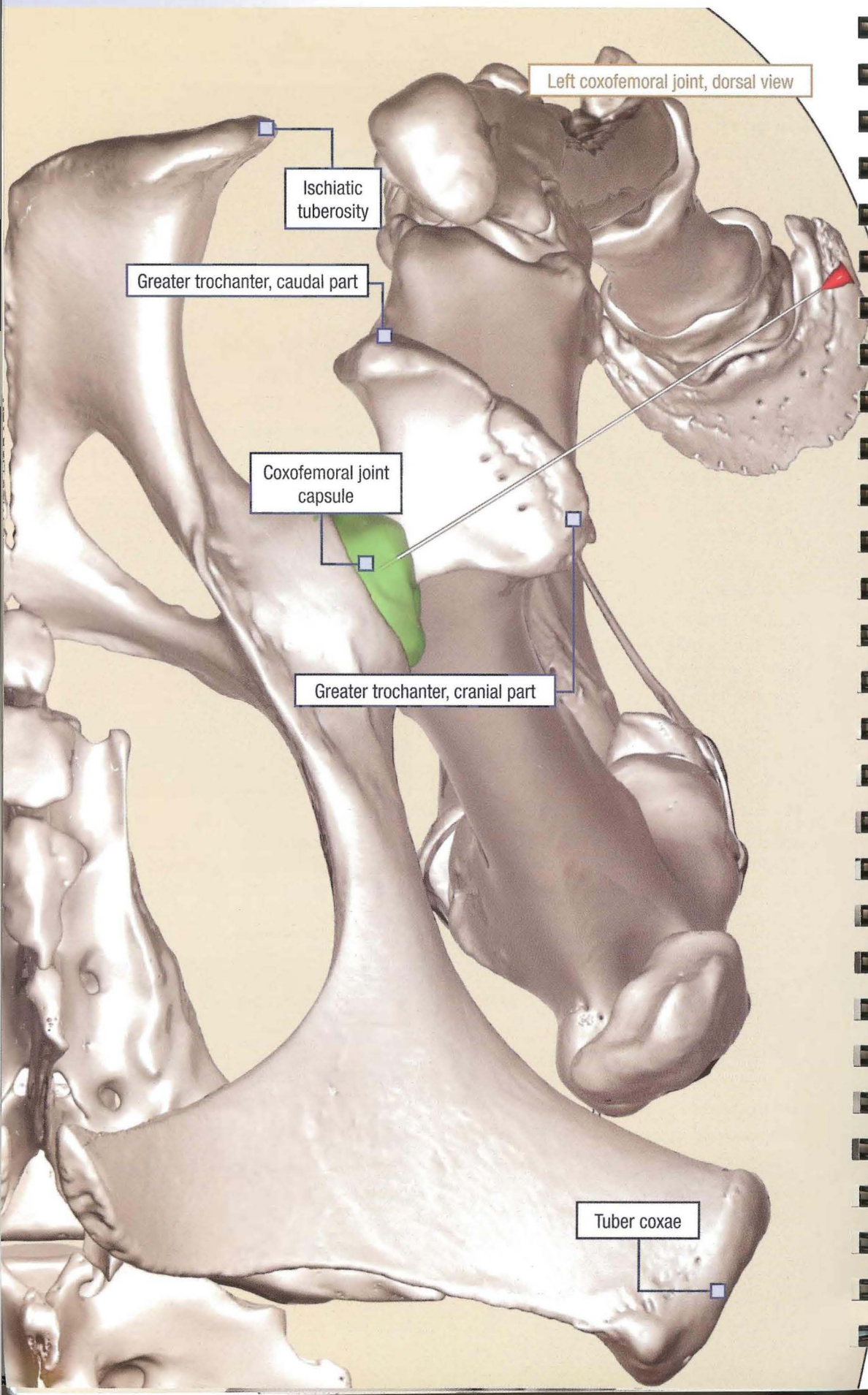
The tape represents an imaginary line drawn from the palpable tuber coxae to the tuber ischii. The greater trochanter is situated approximately two-thirds of the distance between the tuber coxae and tuber ischii. *Note: Left side*

Insert the needle approximately 0.5 inch (1.3 cm) above the palpable edge of the cranial part of the greater trochanter, and direct it slightly craniomedially towards the vertebral column. The joint is usually penetrated at a depth of about 4 to 6 inches (10 to 15 cm). *Note: Needle is in the left side.*

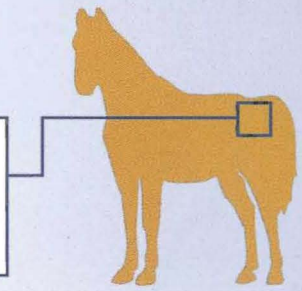
The tape has been reapplied to demonstrate the site of needle insertion (*circled*). *Note: Needle is in the left side.*

COXOFEMORAL JOINT

ALTERNATE DESCRIPTION OF TECHNIQUE



Needle: 3.5 to 6 in. (9 to 15 cm), 18 ga, spinal
Volume: Approximately 40 to 60 mL
Degree of difficulty: 3/3



Another description of accessing the **coxofemoral joint** requires identification of the cranial part of the greater trochanter, as well as the caudal part. For over-conditioned horses, the landmarks used to perform this technique are difficult to palpate. To access the right coxofemoral joint, the greater trochanter is imagined to be L-shaped and the lower horizontal shelf of the L is palpated. The needle is inserted dorsal to the middle of this shelf and directed horizontally and slightly cranially. To access the left coxofemeral joint, the procedure is the same except the greater trochanter is imagined to be a reversed L (⅃). When the needle is felt penetrating cartilage, retract it a few millimeters and remove the stylet.

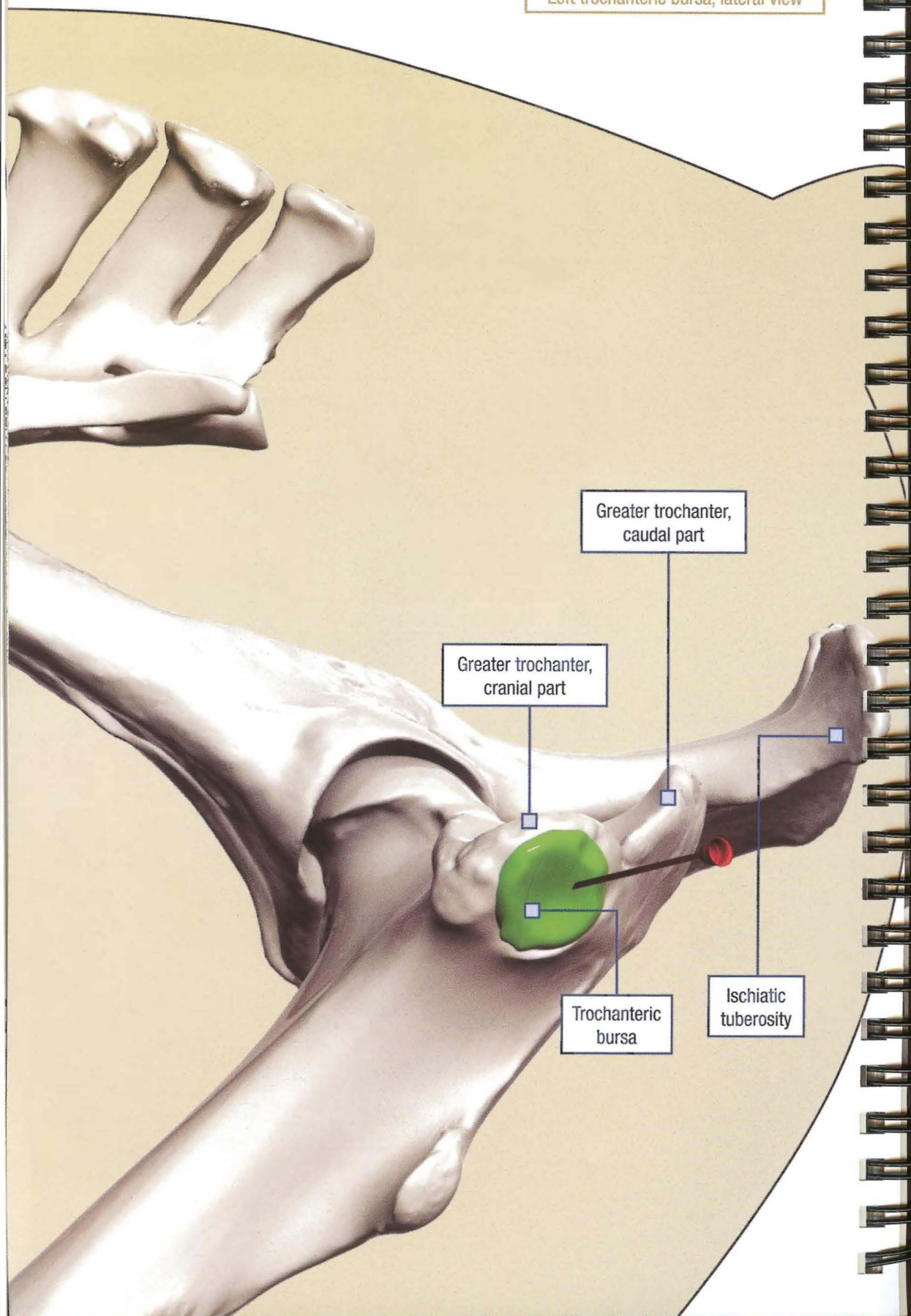
For these techniques, use a flexible spinal needle that bends easily to prevent the needle from inflicting damage to underlying tissue. Limb motion and muscle contraction are the most common reasons for needles to bend during injection of the coxofemoral joint.

If the horse is difficult to restrain, an appropriate dose of xylazine may be useful.

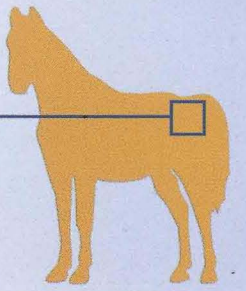
TROCHANTERIC BURSA

LATERAL APPROACH WITH EXTENDED COXOFEMORAL JOINT

Left trochanteric bursa, lateral view



Needle: 3.5 in. (9 cm), 18 to 20 ga, spinal
Volume: 10 to 15 mL
Degree of difficulty: 3/3

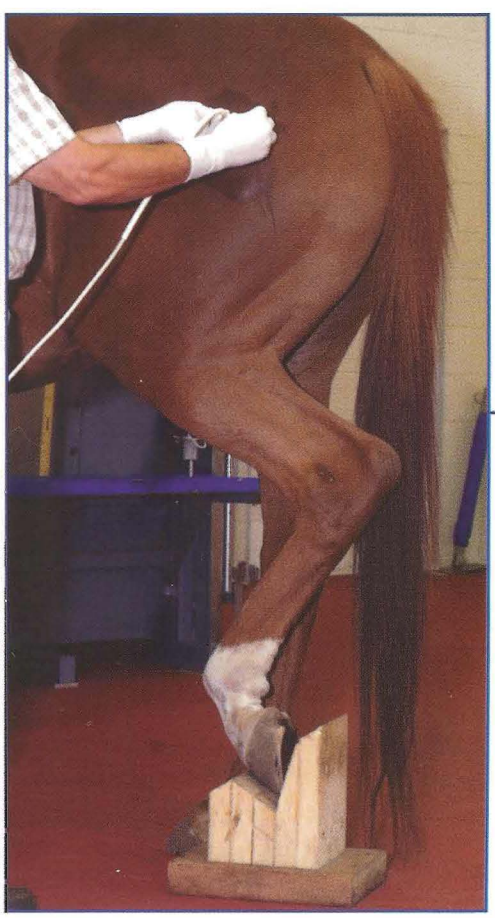


Trochanteric bursitis is inflammation of the **trochanteric bursa**, and the term *whirlbone lameness* refers to lameness caused by it.[70] This condition occurs most frequently in Standarbreds[70,71] but is reported to be a relatively common cause of lameness of horses of all breeds and use.[71] However, the reported high prevalence of this disorder should be viewed with skepticism, because diagnosis of whirlbone lameness is often based solely on clinical signs and results of physical examination without the use of diagnostic analgesia to localize the site of pain causing lameness to the trochanteric bursa.

The trochanteric bursa is located beneath the flat tendon of the accessory gluteal muscle, which passes over the cranial part of the greater trochanter and lies tightly against it when the horse bears weight on the limb.[72] Several techniques have been described for centesis of the trochanteric bursa of horses,[55,73] but the most reliable technique is that described by Tóth et al.[74] Using this technique (shown below), the horse may show signs of discomfort when the needle contacts bone. The needle should not be inserted through the guide-channel of the ultrasound probe because placing the needle through the biopsy channel anchors the probe to the horse, and movement by the horse moves the trochanter from the field of view. Distension of the trochanteric bursa is observed when anesthetic solution is injected into the bursa, and anesthetic solution injected into the bursa can often be aspirated.

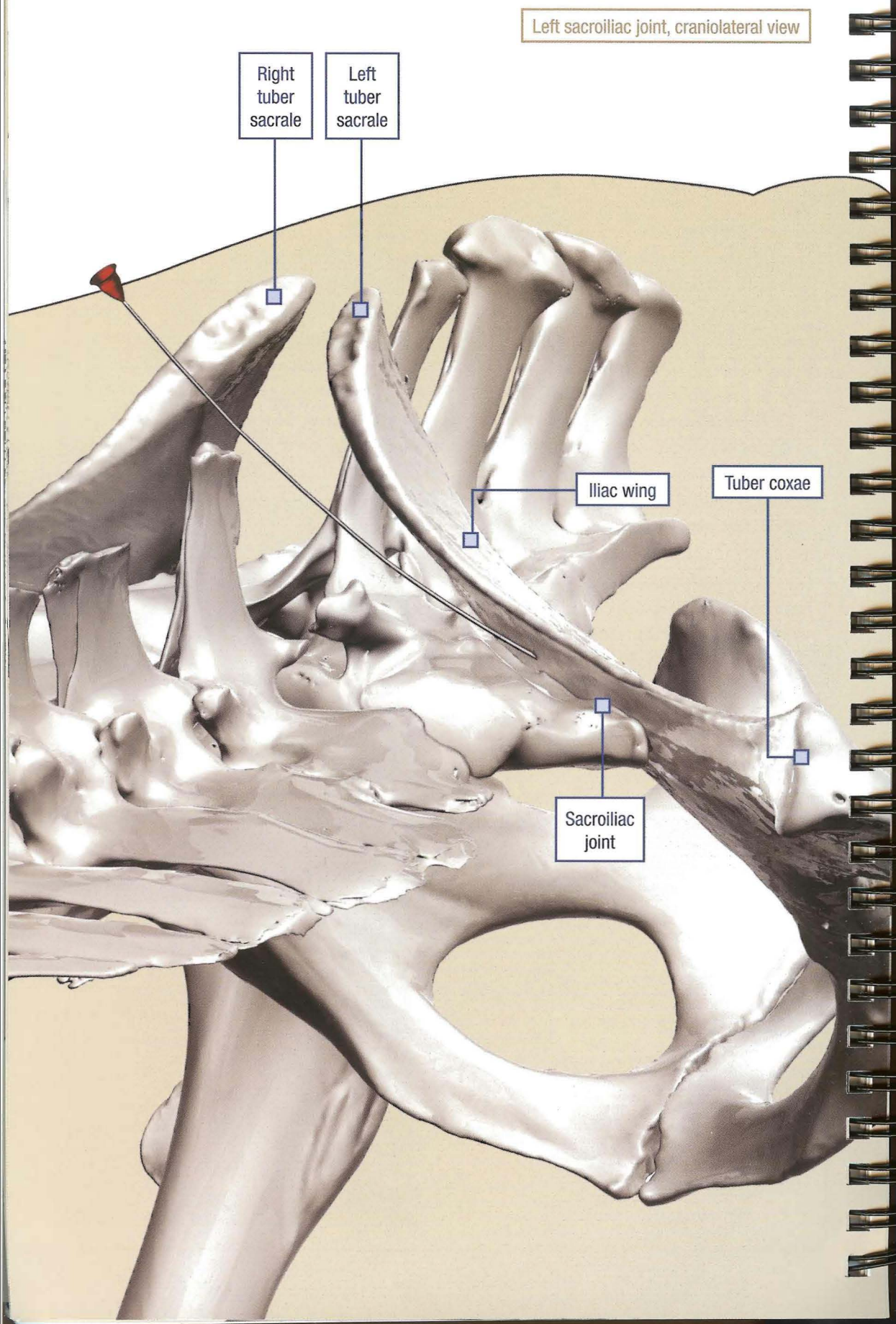
Failure to extend the coxofemoral joint during injection of the **trochanteric bursa** is likely to result in deposition of local anesthetic solution into the tendon of insertion of the accessory gluteal muscle because this tendon lies tightly against the greater trochanter when the horse bears weight on the limb. The short bevel of a spinal needle makes peribursal injection less likely than if a hypodermic needle with a standard bevel is used.

To access the **trochanteric bursa**, the coxofemoral joint is extended by placing the foot in a Hickman block. The most proximal aspect of the cranial part of the greater trochanter, over which the **trochanteric bursa** is positioned, is palpated. The needle is inserted, using ultrasonographic guidance, until the needle contacts bone. Distension of the **trochanteric bursa** is observed when local anesthetic solution is injected into the bursa. *Note: Left side is shown.*

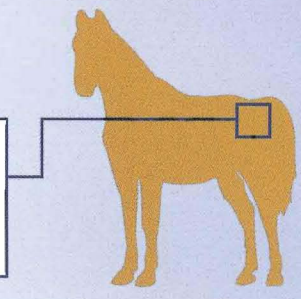


SACROILIAC JOINT

PERIARTICULAR CRANIOMEDIAL APPROACH

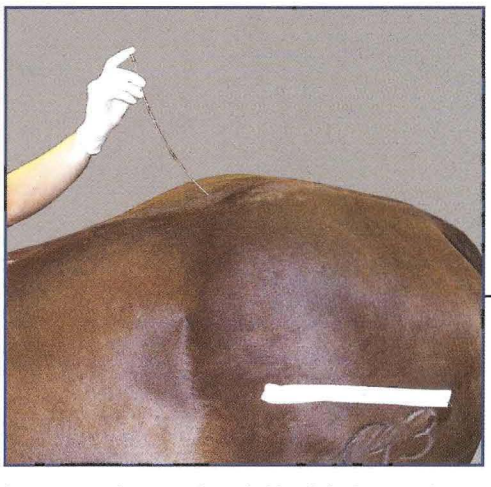


Needle: 10 in. (25 cm), 15 to 16 ga, spinal
Volume: Approximately 6 to 8 mL
Degree of difficulty: 3/3



The **sacroiliac joint** is not readily accessible; therefore, medication is administered periarticularly. The **craniomedial approach** to the sacroiliac joint described by Engeli and Haussler[75] is technically difficult but allows placement of the injected medium adjacent to the medial aspect of the joint, avoiding neurovascular structures that pass through the greater sciatic foramen, such as the sciatic nerve and cranial gluteal artery. Sedation of the horse and subcutaneous anesthesia of the injection site are recommended. The horse should bear weight equally on the pelvic limbs. Before being inserted, the needle should be bent to an angle of approximately 40° in the direction of the needle's bevel. With the bevel facing upward, insert the needle at a 40° angle to the horizontal plane through a stab incision created about 1 inch (2.5 cm) cranial to the contralateral tuber sacrale. Advance the needle across the dorsal midline, aiming for a point midway between the caudal aspect of the ipsilateral tuber coxae and the cranial part of the greater trochanter of the femur until the needle shaft encounters the medial aspect of the ipsilateral iliac wing. Tape applied to the ipsilateral pelvic landmarks (tuber coxae, greater trochanter, and midpoint) facilitates the procedure. The needle hub is elevated, and the curved needle is advanced at a steeper angle (i.e., 50°), allowing it to advance along the medial aspect of the iliac wing until it engages the dorsal surface of the sacral wing at about 6 to 8 inches (15 to 20 cm) of needle depth, depending on the size of the horse. If bone contact is not felt, the needle should be withdrawn and redirected either cranial or caudal to ensure needle contact along the medial aspect of the iliac wing. Ultrasonography can be used to ensure that the needle passes under, rather than over, the iliac wing.

The point of the needle encounters the caudomedial aspect of the sacroiliac joint and is invariably placed periarticularly. Needles smaller than 15 gauge may not be rigid enough to maintain the bend applied to the needle before injection. Occasionally, motor nerves may be inadvertently anesthetized when injecting local anesthetic solution, resulting in temporary paralysis of the pelvic limb. When disease of this joint is suspected, some clinicians prefer to inject a corticosteroid instead of local anesthetic solution (to avoid anesthetizing motor nerves) and then base diagnosis on response to therapy.

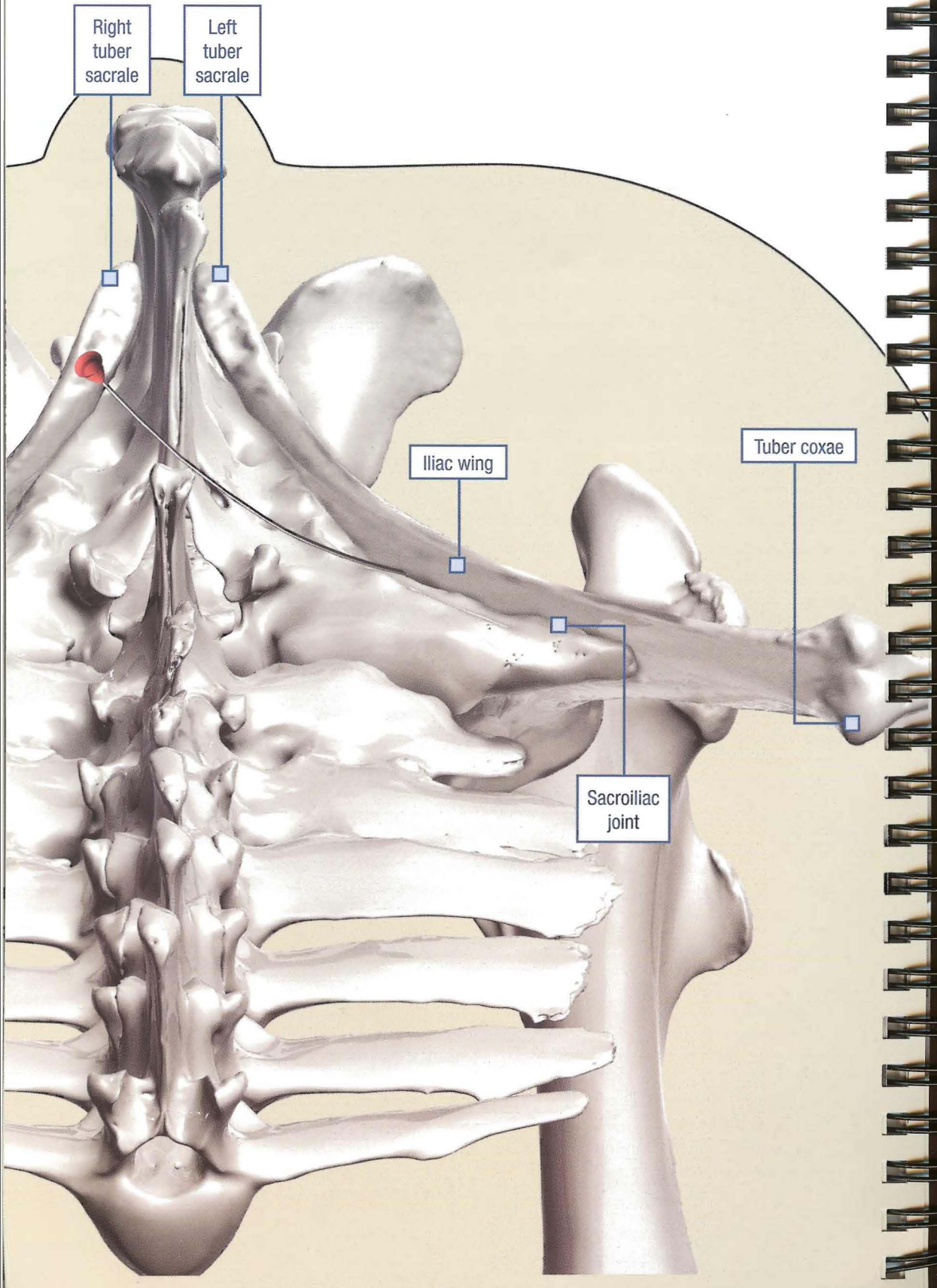


Standing on the contralateral side of the horse, advance the needle across the dorsal midline, aiming for a point midway between the caudal margin of the ipsilateral tuber coxae and the cranial part of the greater trochanter of the femur. *Note: Needle is inserted on the right side of the horse and directed to the left side.*

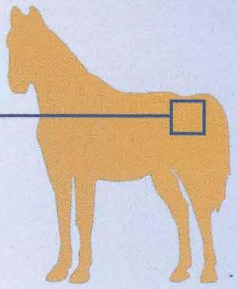
SACROILIAC JOINT

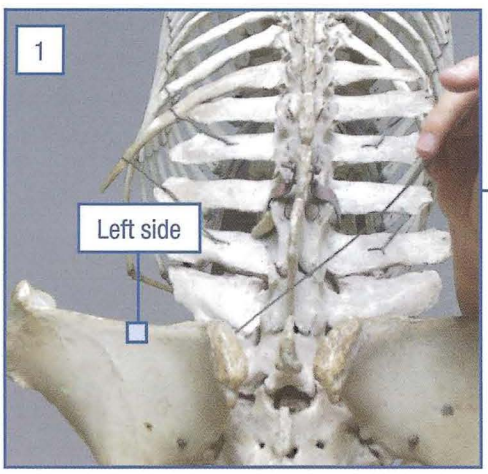
CONTINUED

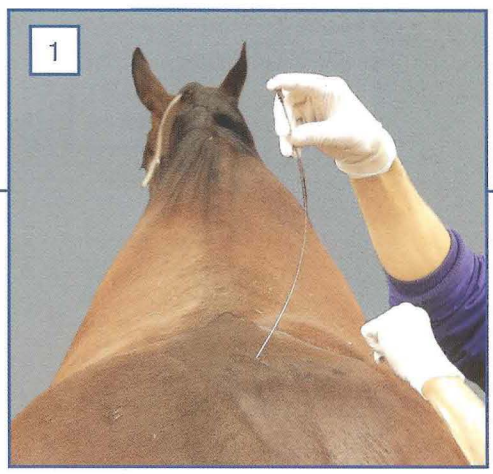
Left sacroiliac joint, craniodorsal view

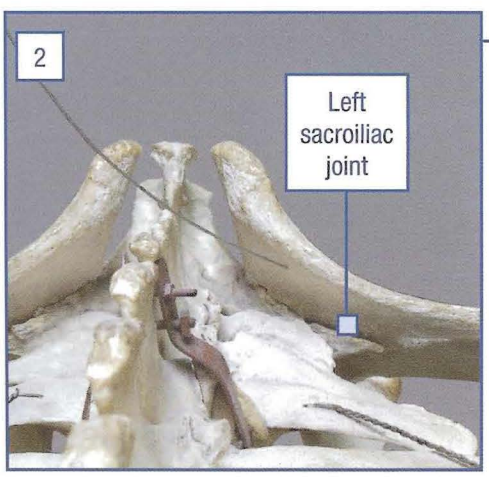


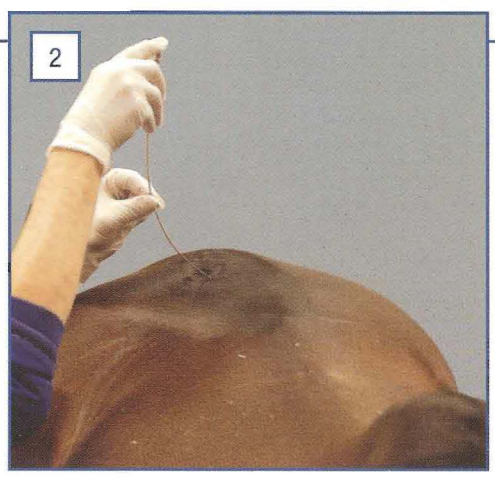
Needle: 10 in. (25 cm), 15 to 16 ga, spinal
Volume: Approximately 6 to 8 mL
Degree of difficulty: 3/3









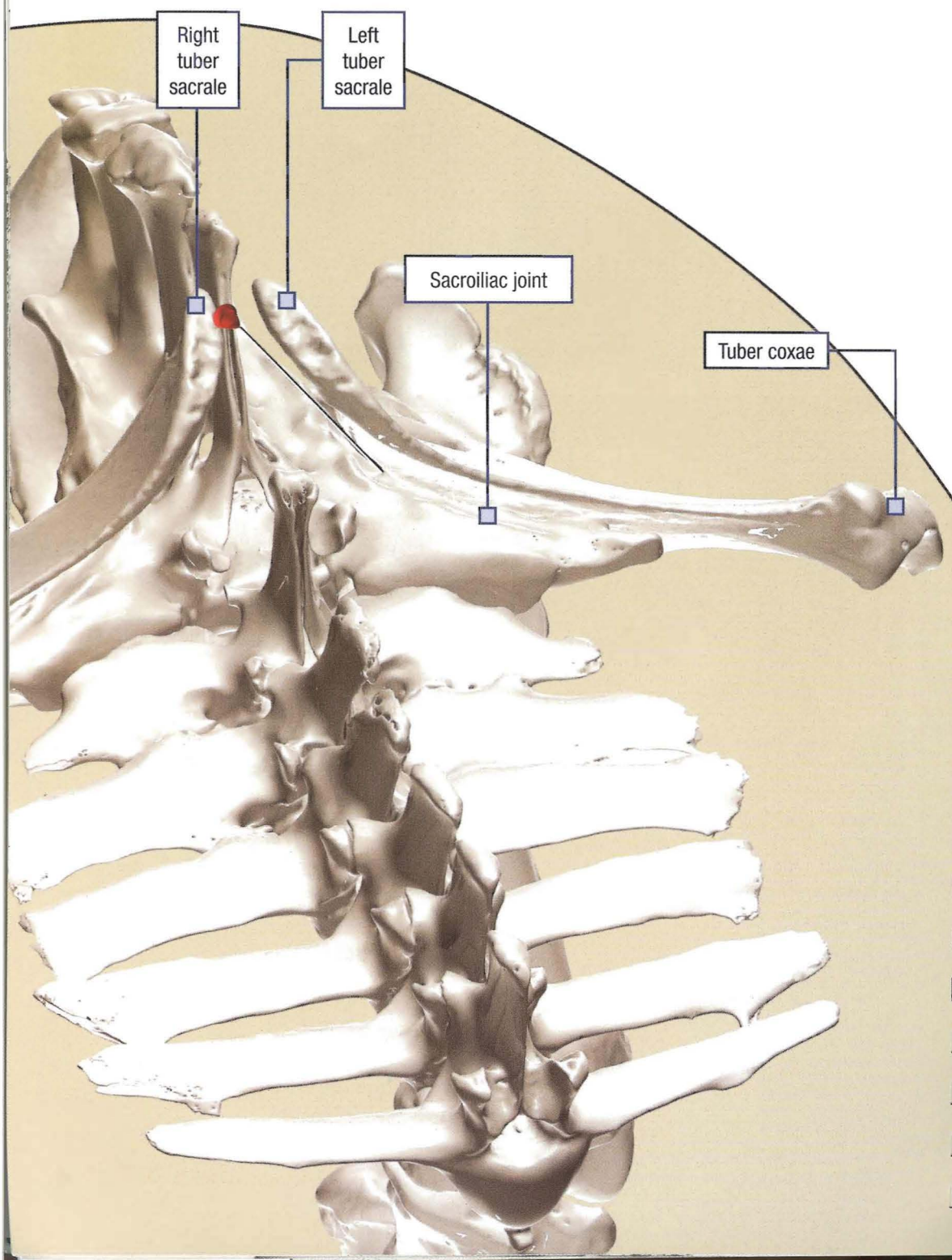


The pictures illustrate injection of the left sacroiliac joint. 1. Standing on the contralateral side of the horse, introduce the needle on the right of dorsal midline. 2. Advance the needle across midline, at an angle of approximately 40° to the horizontal plane with the bevel facing upward through a stab incision created about 1 inch (2.5 cm) cranial to the contralateral tuber sacrale.

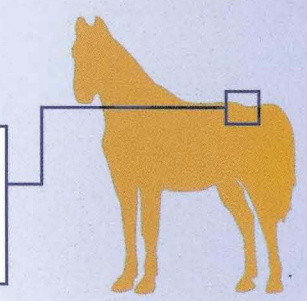
SACROILIAC JOINT

MEDIAL APPROACH

Pelvis, craniodorsal view

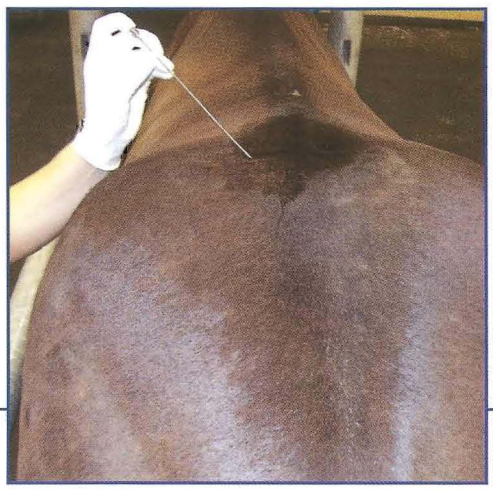


Needle: 10 in. (25 cm), 16 to 18 ga, spinal
Volume: Approximately 10 to 20 mL
Degree of difficulty: 3/3



Techniques that deposit larger volumes (i.e., 10 to 20 mL) of local anesthetic solution less precisely in the sacroiliac region may anesthetize both the sacroiliac joint and the dorsal sacroiliac ligament and do not allow the clinician to distinguish between various potential sources of pain originating from the sacroiliac region.[75]

A **medial approach**, which is a less precise technique than the craniomedial approach described previously (pages 76-79) for desensitization of the sacroiliac region, involves insertion of a 10-inch (25-cm), 16- or 18-gauge needle near the cranial aspect of the contralateral tuber sacrale. Advance the needle in a ventrocaudolateral direction toward the sacroiliac joint of the opposite side at an angle of 20° to 40° to the vertical plane and deposit 20 mL of local anesthetic solution or corticosteroid.[76]

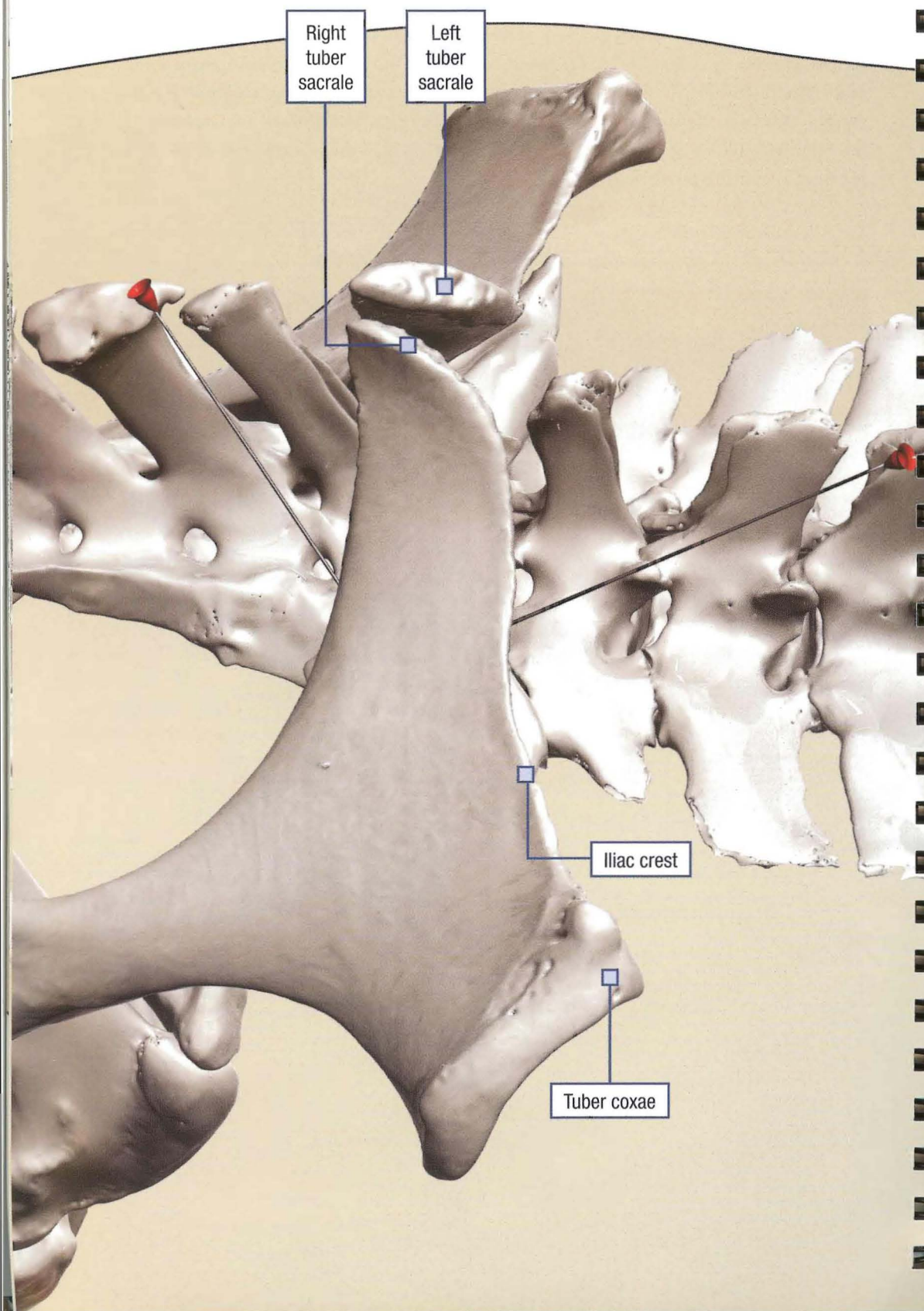


To perform a medial approach to the **sacroiliac joint**, while standing on the contralateral side of the horse, insert an 18-gauge, 10-inch (25-cm) needle near the cranial aspect of the tuber sacrale and advance it in a ventrocaudolateral direction toward the **sacroiliac joint** of the opposite side at an angle of 20° to 40° to the vertical plane. *Note: The right sacroiliac joint is approached in this horse.*

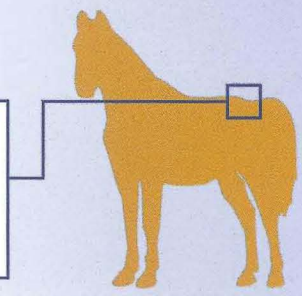
SACROILIAC JOINT

ULTRASONOGRAPHIC-GUIDED APPROACHES

Pelvis, right side, dorsolateral view



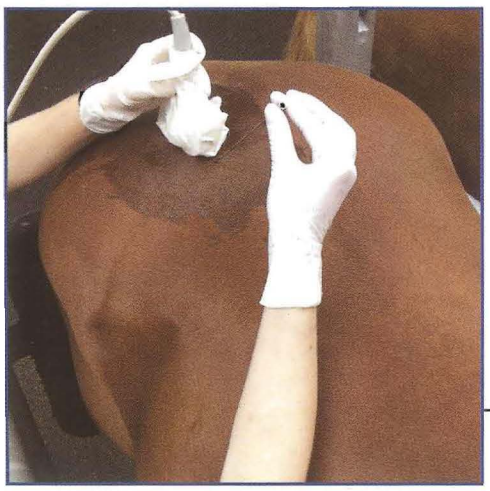
Needle: 10 in. (25 cm), 15 to 16 ga, spinal
Volume: Approximately 6 to 8 mL for cranial approach only*
Degree of difficulty: 3/3



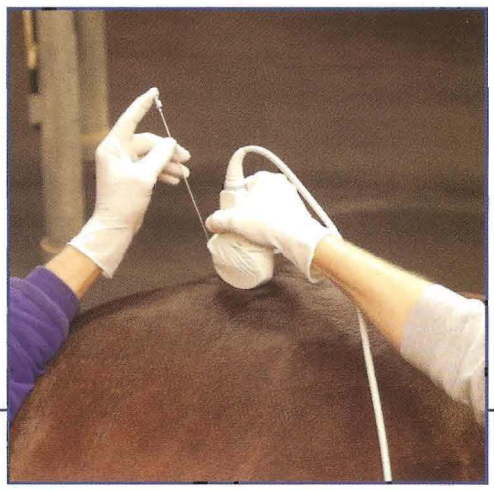
Ultrasonographic guidance for periarticular injection of the **sacroiliac joint** was described by Denoix and Jacquet.[77] Prepare the horse's skin and the probe (5-MHz convex probe) using aseptic technique. Alcohol is used for probe contact with skin. For the **cranial approach**, a 6-inch (15-cm) needle is inserted through the skin on a transverse line joining the cranial aspect of the tuber coxae, 2 to 3 inches (5 to 7 cm) from the dorsal midline. The needle is directed under the ipsilateral wing of the ilium. As soon as the needle is imaged, it is directed ventral to and parallel to the iliac wing caudoventrally until it contacts bone at the dorsal surface of the transverse processes of the lumbar vertebrae or sacrum. The drug is then injected.

For the **caudal approach**, the probe is placed caudal to the ipsilateral tuber sacrale, in a craniolateral to caudomedial oblique plane, leaving 1.5 to 2 inches (3.8 to 5 cm) of space between the probe and the dorsal spinous processes of the sacrum to allow needle placement. The ultrasound probe is centered on the caudal margin of the ipsilateral sacroiliac joint located between the dorsal surface of the sacrum and the caudal margin of the iliac wing. The needle is inserted in the ultrasound beam, between the probe and the dorsal spinous processes of the sacrum, through the middle gluteal muscle, in a caudodorsal to cranioventral direction. As soon as the needle is imaged, it is directed toward the caudal margin of the ipsilateral sacroiliac joint. Injection of local anesthetic solution is not recommended* because of the potential to anesthetize the sciatic nerve.[77]

*Corticosteroids are often administered using the caudal approach.



For the **cranial approach**, a 10-inch (25-cm) needle is inserted through the skin on a transverse line joining the cranial aspect the tuber coxae 2 to 3 inches (5 to 7 cm) from the dorsal midline. The iliac crest should be positioned in the center of the ultrasonographic image. *Note: The right sacroiliac joint is approached in this horse.*

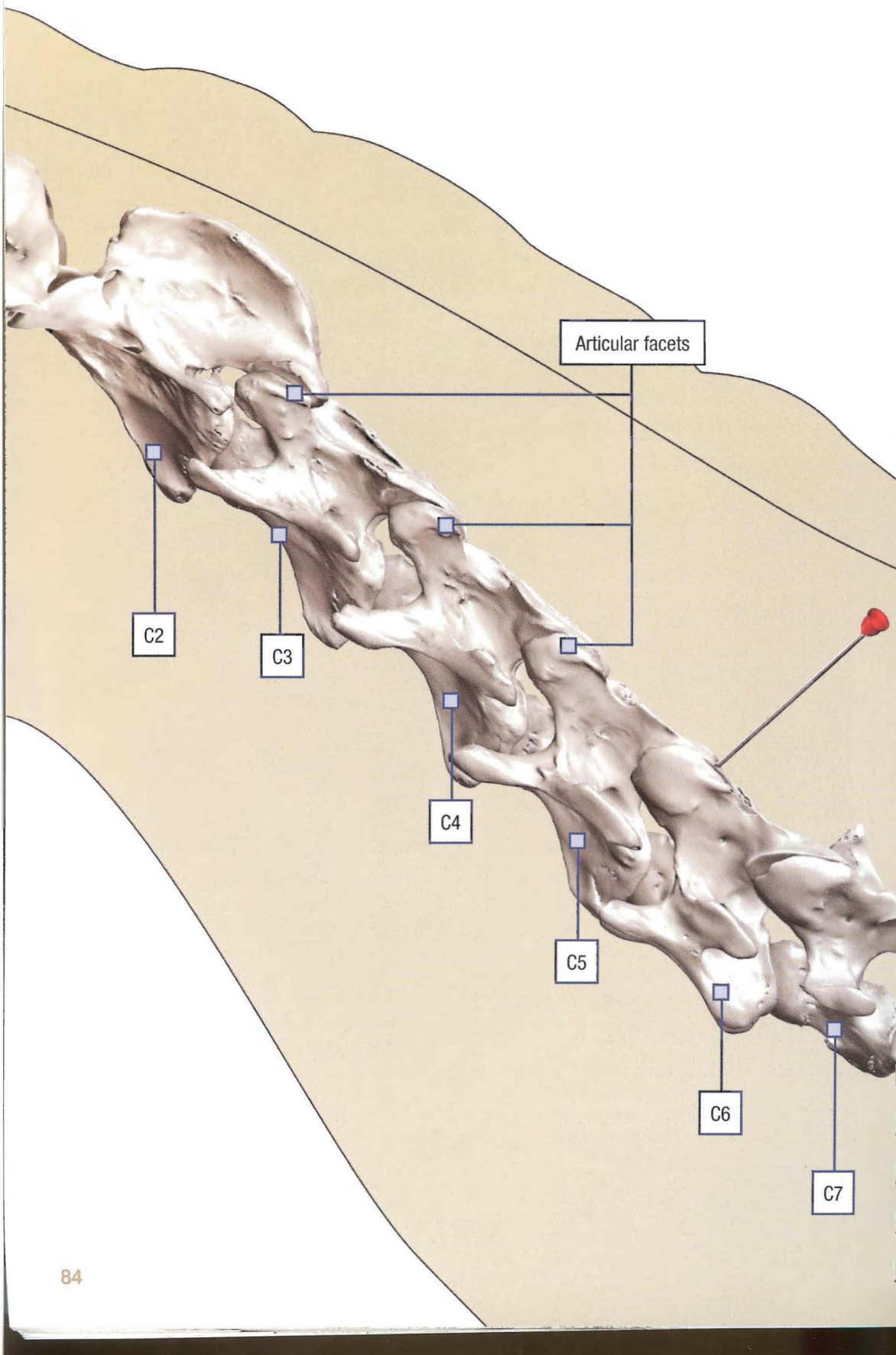


For the **caudal approach**, the ultrasonographic probe is placed caudal to the ipsilateral tuber sacrale, in a craniolateral to caudomedial oblique plane, leaving 1.5 to 2 inches (3.8 to 5 cm) of space between the probe and the dorsal spinous processes of the sacrum to allow needle placement. The ultrasonographic probe is centered on the **caudal sacroiliac joint space**. *Note: The left sacroiliac joint is approached in this horse.*

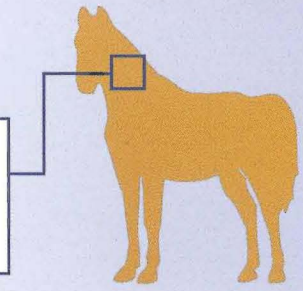
CERVICAL FACET JOINT

DORSOLATERAL TO VENTROMEDIAL APPROACH

Lateral view, left side



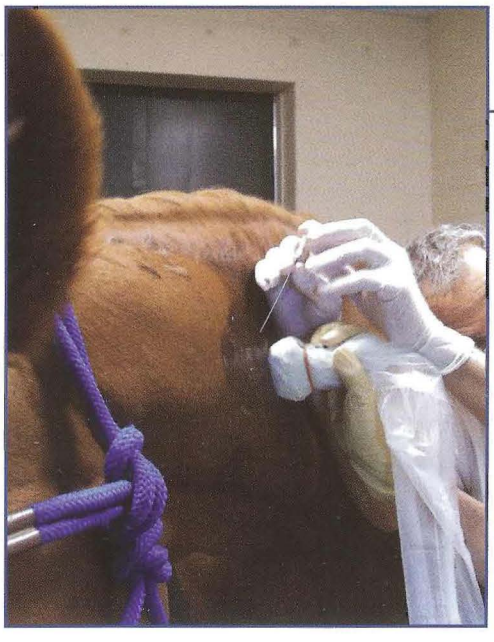
Needle: 3.5 in. (9 cm), 18 to 20 ga, spinal
Volume: Approximately 2 to 3 mL
Degree of difficulty: 3/3



Arthrocentesis of a **cervical facet joint** is generally performed to administer a corticosteroid into the joint of a horse with signs of neck pain and radiographic, ultrasonographic, or scintigraphic evidence of disease of a facet. Lesions are most commonly found in the facet joints joining cervical vertebrae C5 and C6 and C6 and C7.[78]

The cervical vertebrae affected by facet arthropathy are identified using diagnostic imaging, and the approximate site of arthrocentesis is found by placing one hand over the other (the width of each hand corresponding to the length of a cervical vertebra) from the poll along the cervical spine until the approximate location of the diseased facet is located. Sedating the horse with xylazine or detomidine facilitates the procedure. The region of the site of arthrocentesis is scrubbed, and the diseased joint between two adjacent articular facets is identified ultrasonographically using a 7.5-MHz linear probe shrouded in a sterile glove (or scrubbed with disinfectant) in the center of the imaging field. For heavily muscled horses or for imaging C6 to C7, a lower frequency probe may be required.[79] With the ultrasonographic probe in place, administer local anesthetic solution subcutaneously using a 5/8-inch (1.6-cm), 25-gauge needle (optional). Insert a 3.5-inch (9-cm), 18- to 20-gauge spinal needle and advance it at an approximately 20° angle from the probe, aiming toward the approximate site of the joint.[78] Using ultrasonographic guidance, direct the needle into (or at least close to) the joint space and inject the drug (usually a corticosteroid). If the needle is within the joint, the drug cannot be seen ultrasonographically as it is administered.

The needle cannot be placed in some joints with advanced arthropathy; however, periarticular administration of corticosteroid may be beneficial for these horses. A danger of injecting a cervical facet is inadvertent placement of the needle and administration of drug within the spinal cord, which may cause permanent neurologic damage. To avoid this complication, the spinal needle, under ultrasonographic guidance, should be advanced only slightly past the joint margin.[79]

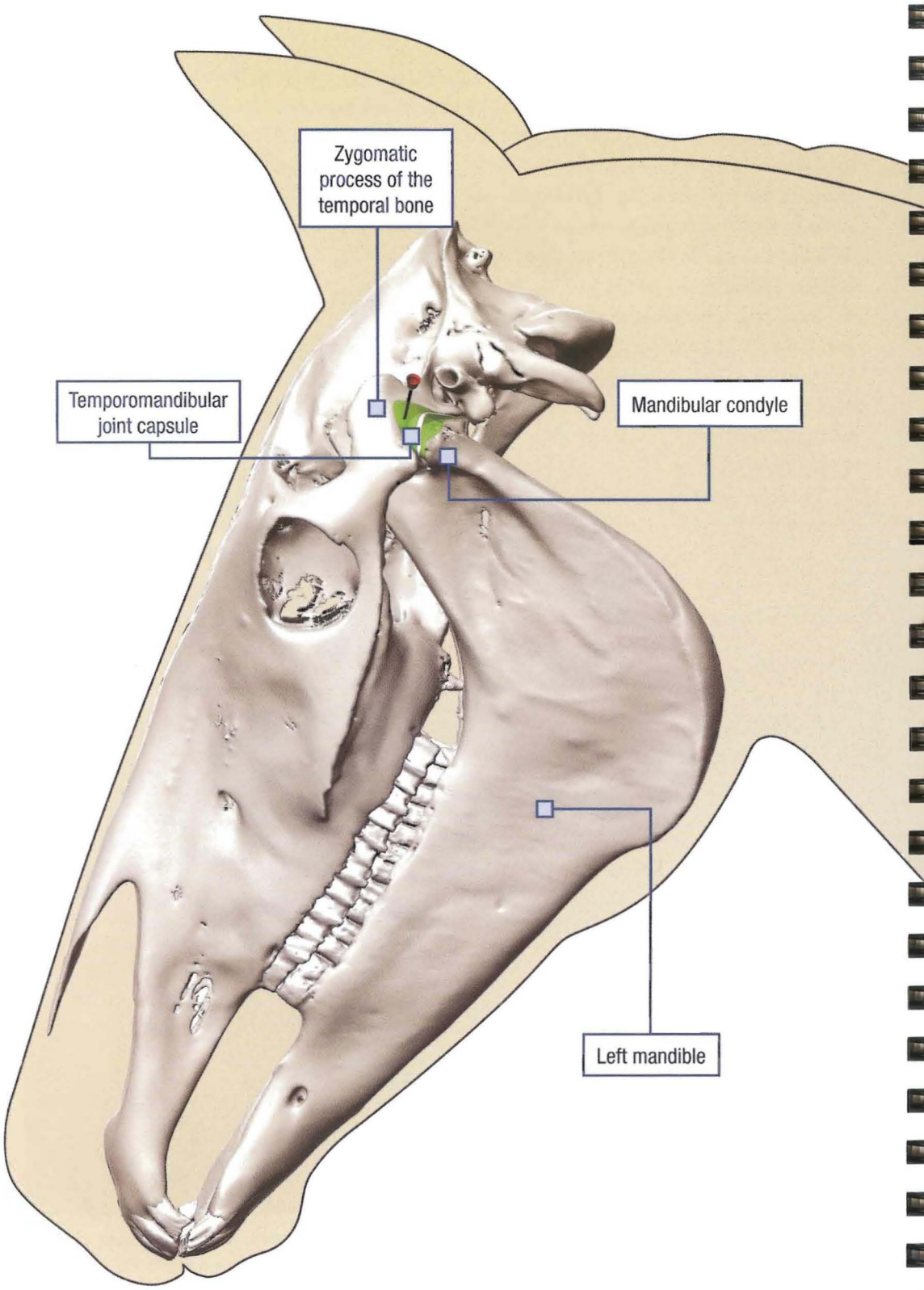


With an ultrasonographic probe in place, insert a 3.5-inch (9-cm), 18- to 20-gauge spinal needle and advance it at an angle, aiming toward the approximate site of the joint. *Note: Needle is in the left side.*

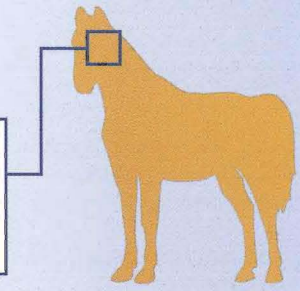
TEMPOROMANDIBULAR JOINT

APPROACH TO CAUDAL POUCH OF THE DISCOTEMPORAL JOINT

Lateral view, left side



Needle: 1 to 1.5 in. (2.5 to 3.8 cm), 20 to 22 ga
Volume: Approximately 2 to 3 mL
Degree of difficulty: 2/3

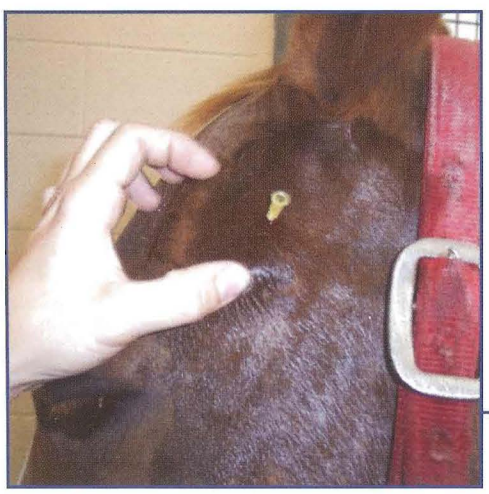


The **temporomandibular joint** is the articulation between the mandibular condyle and the base of the zygomatic process of the temporal bone.[80] It is composed of a small ventral compartment and a larger dorsal compartment, which are separated by a fibrocartilaginous disk. The dorsal compartment is composed of a rostral and a caudal pouch. Whether the dorsal and ventral compartments of the joint communicate is disputed,[80,81] but we believe that they do not.

Disease of the temporomandibular joint of horses is uncommonly reported, perhaps because imaging this joint is difficult. Recognition of disease of this joint may increase as the use of sophisticated imaging systems (e.g., digital radiography, ultrasonography, computed tomography, magnetic resonance imaging) to examine various regions of the horse increases.

The temporomandibular joint is entered with the horse sedated. The mandibular condyle is identified as a smooth protrusion about midway between the lateral canthus of the eye and the base of the ear. Its identity can be confirmed by palpating the structure while an assistant manipulates the mandible from side to side. The zygomatic process of the temporal bone is palpated several centimeters dorsal to the mandibular condyle, and a line is imagined between these structures. The site of arthrocentesis is midway between these structures and 0.25 to 0.5 inch (0.6 to 1.3 cm) caudal to the the imagined line.[81]

Insert the needle into a depression in a rostral ventral direction to a depth of approximately 1 inch (2.5 cm). Synovial fluid may fill the needle hub. If the needle strikes bone, it should be partially withdrawn and directed more ventrally. If the needle is directed too far ventrally, it may become embedded in the articular disk and should be partially withdrawn. The joint is infused with 2 to 3 mL of local anesthetic solution.



The mandibular condyle is identified as a smooth protrusion approximately midway between the lateral canthus of the eye and the base of the ear (the thumb is situated over the mandibular condyle in this photograph). The zygomatic process of the temporal bone is palpated several centimeters above the mandibular condyle (the index finger rests on the zygomatic process of the temporal bone), and a line is imagined between these structures. The site of arthrocentesisis is midway between these structures and 0.25 to 0.5 inch (0.6 to 1.3 cm) behind the imagined line. *Note: Needle is in the left side.*

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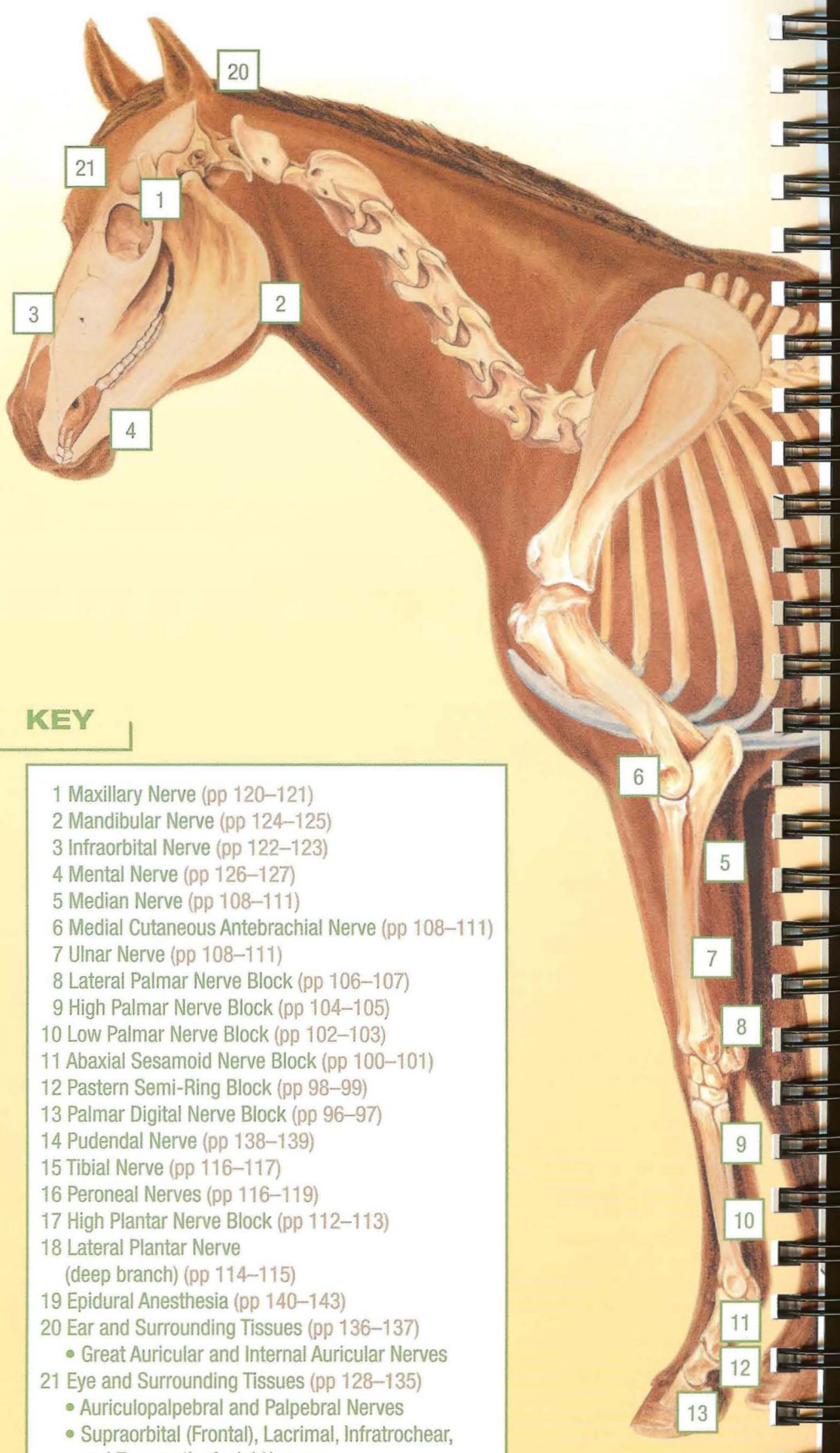

KEY

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2 Mandibular Nerve (pp 124–125)
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21 Eye and Surrounding Tissues (pp 128–135)
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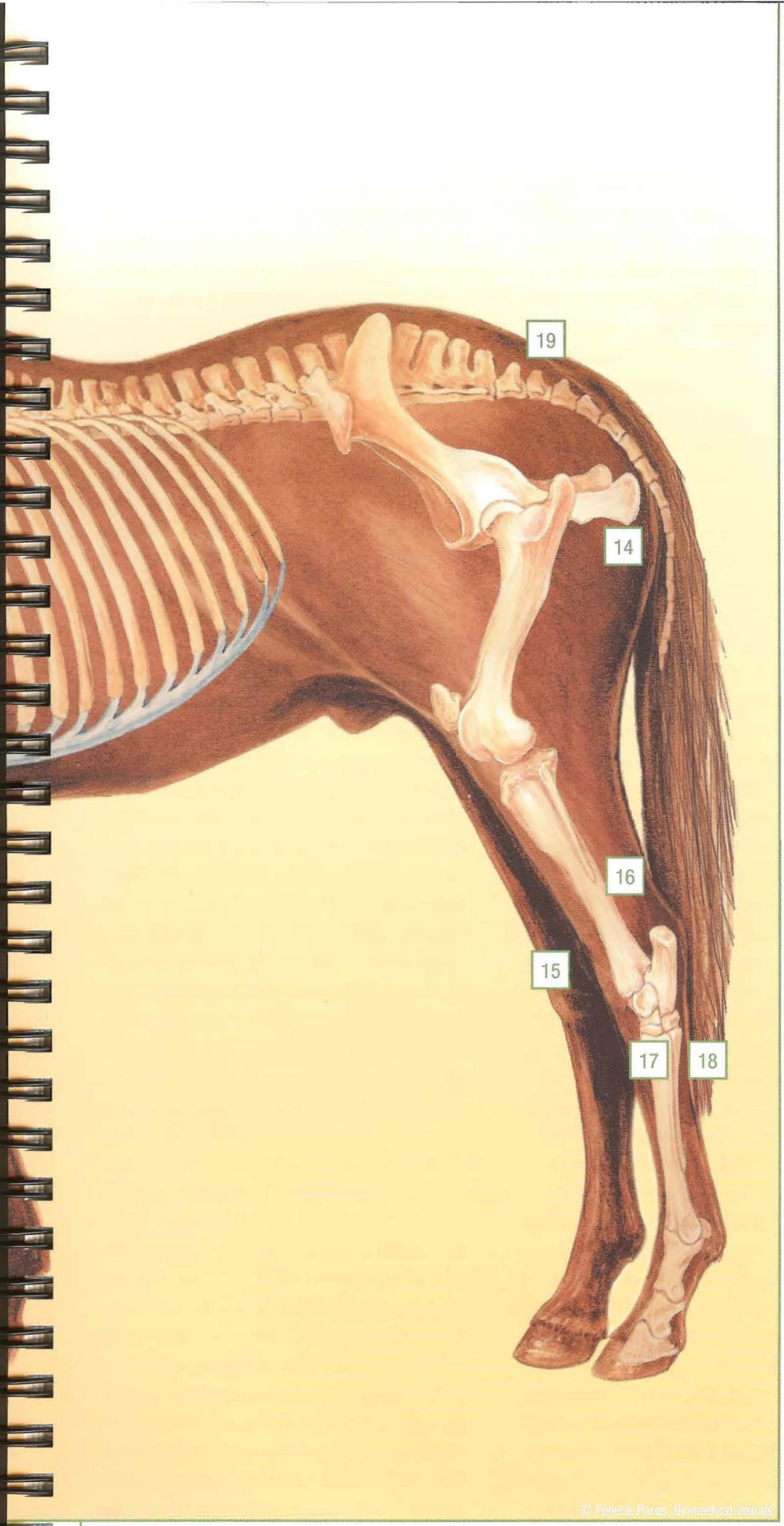
- Retrobulbar Block



INTRODUCTION AND USES

Regional anesthesia is a valuable diagnostic aid for localizing the site of lameness-inducing pain to a particular area of a horse's limb so that other diagnostic procedures, such as anesthesia of a joint, radiography, computed tomography, or magnetic resonance imaging, can be used more effectively and economically to identify the cause of lameness. Regional anesthesia provides supplemental analgesia to anesthetized horses undergoing surgery and allows some surgical procedures to be performed with the horse conscious and standing. Regional anesthesia can also be used to provide temporary relief from chronic pain.

Regional anesthesia is not as precise as intraarticular anesthesia in localizing the site of lameness-inducing pain, but because it requires less preparation at the injection site and anesthetizes both articular and nonarticular structures, it can sometimes be used more efficiently than intraarticular anesthesia to localize the site of pain during a lameness examination.

The two local anesthetic solution agents most commonly used to provide regional anesthesia are 2% lidocaine hydrochloride and 2% mepivacaine hydrochloride. Lidocaine induces anesthesia more slowly, irritates tissue more, and provides a shorter duration of anesthesia than does mepivacaine. Bupivacaine hydrochloride (0.5%) is the local anesthetic solution of choice when regional anesthesia is performed for relief of pain because it provides a longer duration of anesthesia (4 to 6 hours) than that provided by either lidocaine or mepivacaine.

Mepivacaine provides regional anesthesia for 90 to 120 minutes, making it useful for examining horses with lameness of multiple limbs or multiple sites on one limb.

Because lidocaine provides anesthesia for only 30 to 45 minutes, it might be the preferred local anesthetic solution for regional anesthesia when joint analgesia is likely to be used later during the examination of a horse with a single site of pain causing lameness. For example, to further localize the source of pain causing lameness after a horse becomes sound when regional anesthesia has desensitized the pastern and foot regions, local anesthetic solution can be instilled into the coffin joint or pastern joint, but only after results of regional anesthesia have dissipated.

Most nerves of the distal portion of the limb are anesthetized using a ⅝-inch (1.6-cm), 25-gauge needle. Longer (e.g., 1.5-inch [3.8-cm]), larger-gauge (e.g., 20- to 22-gauge) needles are used to anesthetize nerves located more proximally on the limb. If a relatively large-gauge needle is to be used, subcutaneous deposition of a small amount of local anesthetic solution using a 25-gauge needle may avoid resentment and reaction by the horse when the larger-gauge needle is inserted.

The needle should be inserted detached from the syringe to decrease the likelihood of it being bent or broken. Therefore, syringes that lock onto the needle hub (e.g., Luer Lock syringes) should not be used, so that if the horse moves the limb suddenly, the syringe can be detached quickly to prevent the needle from being removed, bent, or broken.

The volume of local analgesic used to anesthetize nerves located in the distal portion of the limb is usually less than the amount used to anesthetize nerves in the proximal portion of the limb. This is because distal nerves are smaller and more superficially located, which allows for more accurate placement of the solution. When the goal of regional anesthesia is to identify a site of pain causing lameness, the smallest volume of local anesthetic solution likely to be effective should be administered to avoid inadvertently anesthetizing adjacent nerves.

Pain is usually relieved within 5 minutes after administering a local anesthetic solution near a nerve in the distal portion of the limb, but onset of pain relief may take 20 minutes or more when anesthetizing the large nerves of the proximal portion of the limb. Results of a diagnostic regional nerve block can be misinterpreted if the horse's gait is assessed before the onset of pain relief. Regional nerve blocks administered in the proximal portion of the limb can hinder proprioception, which can create gait abnormalities and even cause stumbling.

The effectiveness of a regional block applied to alleviate lameness can be assessed by evaluating the gait. A positive response to a regional block indicates that the block was accurately achieved. A negative response indicates that the site of pain was not within the region supplied by that nerve or that the nerve was not anesthetized. The effectiveness of a regional nerve block in desensitizing a particular region can also be assessed by applying sharp pressure to the skin

over that region using a ballpoint pen or key; however, the effectiveness can be misinterpreted if only the skin has been desensitized or if the skin has not been desensitized but structures deep to it have been desensitized.

Inadvertently administering a local anesthetic solution into a blood vessel, joint, tendon sheath, or bursa, rather than perineurally, may lead the clinician to misinterpret the results of the nerve block; possible variations in neuroanatomy may also provide misleading information concerning the site of pain causing lameness. Therefore, results of diagnostic regional anesthesia should be interpreted with some degree of skepticism.

PREPARATION OF THE SITE

Local anesthetic solution can often be administered for regional anesthesia after wiping the site of injection liberally with cotton pledgets or gauze sponges soaked in 70% isopropyl alcohol. If an adjacent synovial structure is at risk of being penetrated, the site of injection should be prepared more carefully by scrubbing with an antiseptic soap. The consequences of subcutaneous infection are usually minor, but infection of an inadvertently penetrated synovial structure could be disastrous. Inadvertent and unrecognized penetration of the digital flexor sheath may occasionally occur when performing perineural anesthesia of the nerves of the lower portion of the limb.[1] Clipping the site of injection for regional anesthesia is not necessary unless doing so aids in palpation of landmarks.

MANAGEMENT OF THE HORSE

Horses often require minimal restraint or a nose twitch for many of these procedures; however, not all horses respond to restraint methods in the same way. It may be necessary to use other methods of restraint, such as a lip chain, to control a fractious horse. The twitch is most effective when applied immediately before needle placement. Restraining the horse in stocks to perform regional anesthesia of the lower portion of a limb may increase the risk of injury to the clinician and the horse. The clinician's preference and the injection site determine whether the local anesthetic solution is administered with the limb held or bearing weight. When a nerve block on a forelimb is to be performed with the horse standing on the limb, lifting the contralateral forelimb may enhance the safety of the procedure for the clinician, but the clinician should be aware that some horses may collapse the supporting forelimb in reaction to insertion of a needle, resulting in serious injury to the carpus of that limb.

If application of a nose twitch or lip chain does not provide sufficient restraint, acepromazine maleate (0.044 mg/kg IV) or xylazine hydrochloride (0.2 to 0.4 mg/kg IV) can be administered to some horses without significantly interfering with gait assessment.[2–4] The degree to which tranquilization or sedation may interfere with gait assessment may depend on the severity of lameness and the skill of the clinician performing the lameness examination. Because of the uncertainty of the effect of sedatives on gait, these drugs are best avoided if possible. If the clinician is concerned that the effects of sedation may confuse the lameness evaluation, the horse can be examined after the effects of sedation dissipate, provided that anesthesia imparted by the local anesthetic solution persists longer than the effects of the sedative. Waiting until the sedative effects dissipate may, however, confound the results of regional anesthesia because the local anesthetic solution may diffuse, desensitizing structures not intended to be desensitized. If a horse must receive a sedative, such as xylazine, before a local anesthetic solution can be administered, the effects of sedation on gait can be diminished by administering an antagonist to reverse the effects of the sedative.[3] Yohimbine or tolazoline is used to reverse the effects of sedatives in horses.

GENERAL TECHNIQUE

To accurately perform regional anesthesia, a good understanding of the relevant anatomy is necessary; a fresh review of the anatomy and injection technique may be prudent when performing some of the less frequently used blocks (e.g., on the proximal portion of the limb). The clinician must not only be able to accurately perform the regional injection technique, but he or she must also be aware of the structures that are consistently desensitized by a particular nerve block.

Some clinicians recommend walking the horse for 5 to 10 minutes after administering perineural anesthesia before assessing the results. Walking allows the horse to become

habituated to desensitization of a portion of a limb.[5] Other clinicians prefer to confine a horse after a nerve block because they believe walking may increase proximal diffusion of local anesthetic solution, causing desensitization of more proximal structures and complicating interpretation of a nerve block. However, walking does not significantly influence the extent of either proximal or distal diffusion of contrast solution after perineural injection.[6]

FORELIMB NERVE BLOCKS

When desensitizing a forefoot, we prefer to hold the limb while facing the opposite direction of the horse, but some clinicians prefer to perform these procedures facing the same direction as the horse. When facing the same direction as the horse, the horse's foot can be held between the clinician's knees to free both hands for the procedure. In this position, however, the clinician is at risk of injury if the horse swings its limb caudally. When facing the opposite direction as the horse, the clinician must perform the block using a single hand because one hand must hold the limb.

For nerve blocks of the lower portion of the limb, a ⅝-inch (1.6-cm), 25-gauge needle is commonly used. The needle is inserted subcutaneously directly over the nerve and directed distally. The needle should not be directed proximally because proximal diffusion of local anesthetic solution may desensitize more structures than intended. Depositing the local anesthetic solution in different tissue planes and as the needle is withdrawn increases the likelihood of rapid contact of the solution with the nerve but may also increase the likelihood of anesthetizing structures not intended to be desensitized.

HINDLIMB NERVE BLOCKS

Techniques for anesthesia of the distal portion of the hindlimb are similar to those for the forelimb. The clinician should be aware, however, that in the hindlimb, the dorsal aspect of the coronary band, the dorsal laminae of the foot, and the dorsal aspect of the pastern and fetlock joints are at least partially innervated by the lateral and medial dorsal metatarsal nerves, which are branches of the deep peroneal (fibular) nerve.[7]

As depicted in Figure 2, the medial dorsal metatarsal nerve courses along the medial side of the long digital extensor tendon and can be anesthetized by injecting 2 to 3 mL of local anesthetic solution subcutaneously on the medial side of the long digital extensor tendon at the level of the distal end of the medial splint bone. The lateral dorsal metatarsal nerve courses distally in the metatarsal region close to the lateral splint bone and deviates dorsally in the region of the fetlock. This nerve can be anesthetized, along with the lateral plantar metatarsal nerve, by injecting 2 to 3 mL of local anesthetic solution subcutaneously slightly dorsal to the distal end of the lateral splint bone. Most lameness of the lower portion of the limb, however, can be evaluated accurately without anesthetizing the dorsal metatarsal nerves.[8]

INJECTION STRATEGIES

Specific, step-by-step details of different techniques for administering regional anesthesia are discussed and illustrated in the pages that follow. For each regional block, we have given an approximate needle size. The amount of local anesthetic solution instilled perineurally is arbitrary and depends on whether the block is intended for diagnostic purposes or to achieve surgical anesthesia or temporary relief of chronic pain. We have stated a volume of fluid useful for diagnostic purposes. We have omitted assigning a degree of difficulty because the degree of difficulty in performing a nerve block is directly proportional to the number of injections required to achieve the block. For example, a palmar digital nerve block could be considered easier to perform than a low palmar nerve block because the former requires two injections whereas the latter requires four.

COMPLICATIONS

Complications associated with regional anesthesia are rare but could include broken needles, subcutaneous infection, and septic synovitis caused by inadvertent synoviocentesis. The likelihood of breaking a needle while administering regional anesthesia is low, but properly restraining the horse reduces the risk. Subcutaneous or synovial infection is avoided by properly preparing the injection site. If an adjacent synovial structure is at risk of being penetrated by the needle, the injection site should be prepared more meticulously than if synovial structures are remote from the site.

To identify the exact location of the shaft of a broken needle, radiography (with radiographs obtained at multiple angles), ultrasonography, or fluoroscopy may be helpful. The shaft of a broken needle that lies subcutaneously may be palpable, in which case it can be retrieved by incising the skin over the shaft while the horse is sedated or anesthetized. The site of incision is best desensitized with regional anesthesia performed proximal to the site because infiltrating local anesthetic solution around the region of the needle may make palpation of the needle difficult.

Subcutaneous infection can be resolved with systemic administration of an antimicrobial drug likely to be effective on the infective bacteria, usually *Staphylococci*. Bandaging the affected portion of the limb reduces swelling and may decrease discomfort associated with the infection. If an abscess develops, it should be opened to permit drainage. Horses with infection of a synovial structure should be treated as described previously (see Complications in Part 1).

Agents used for regional anesthesia are detectable systemically and could create a problem for the owner and/or trainer if the horse is tested for drugs.

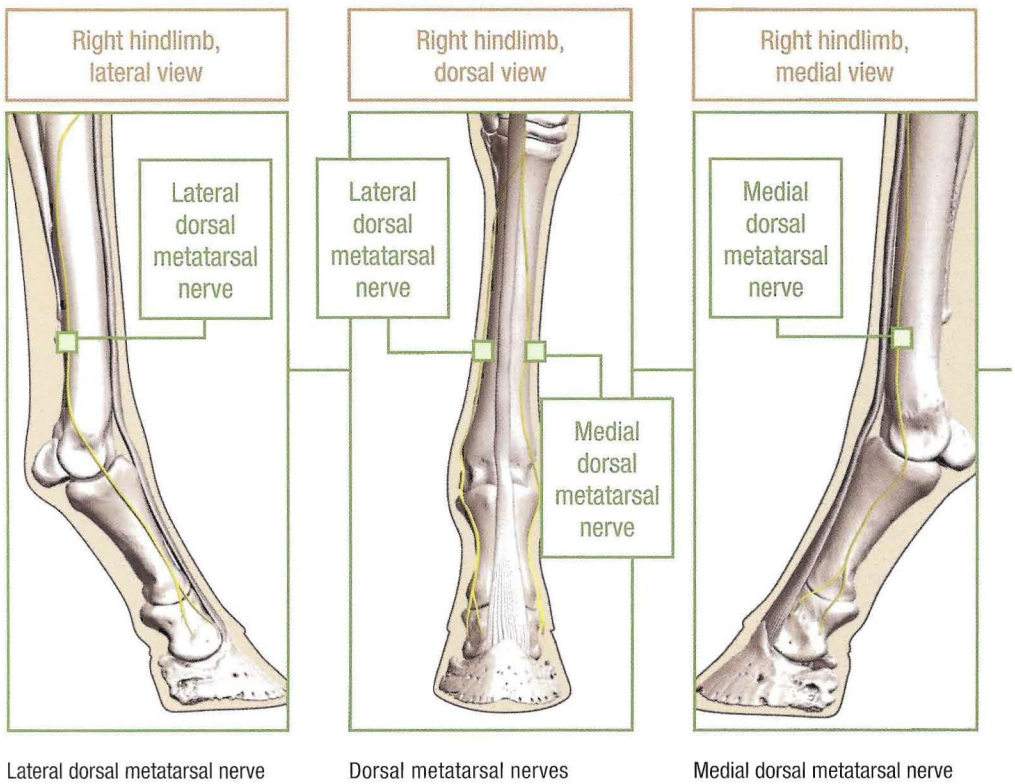
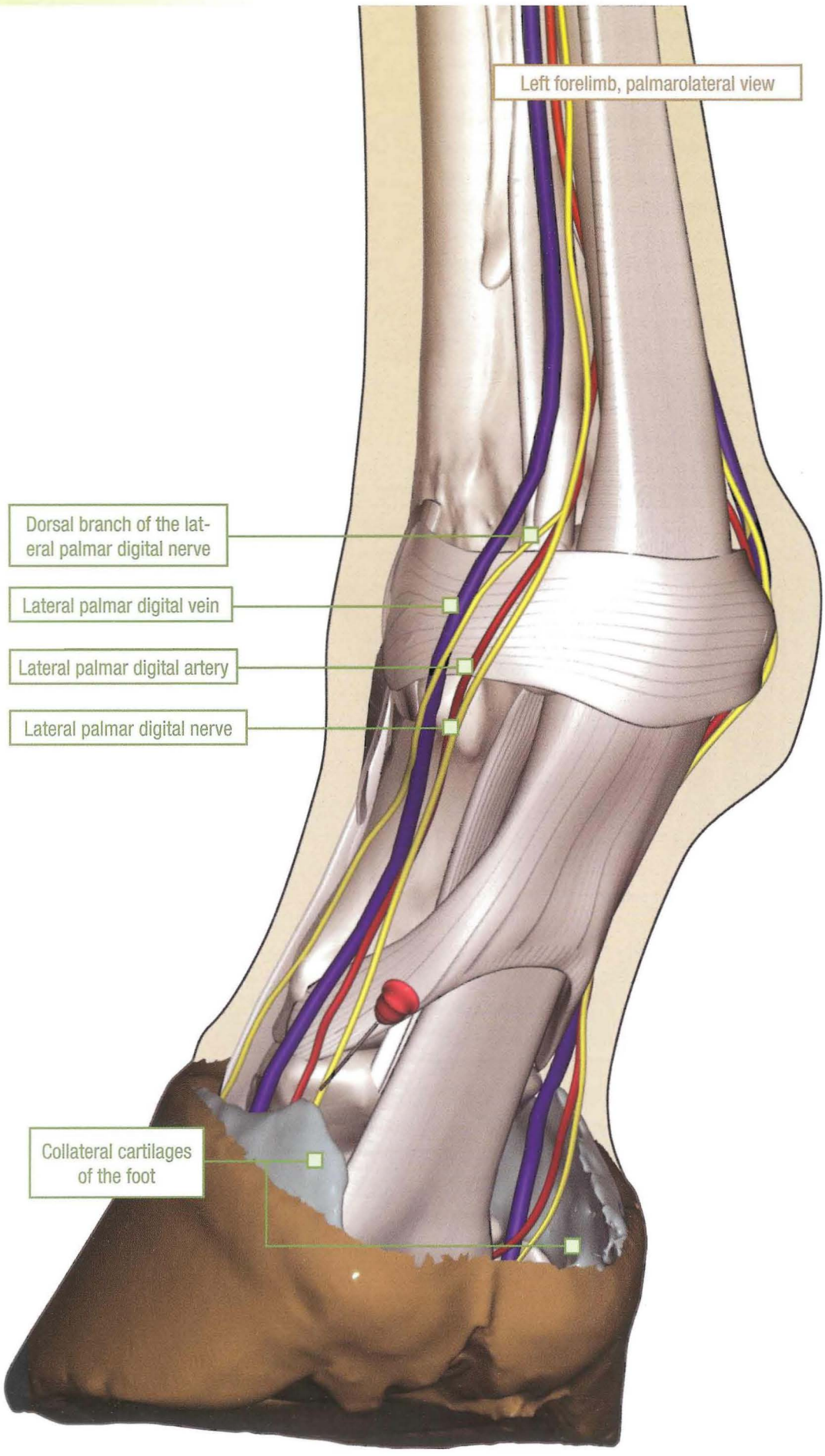
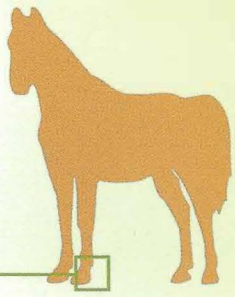


Figure 2: Metatarsal nerves of the hindlimb.

PALMAR DIGITAL NERVE BLOCK



Needle: 5/8 in. (1.6 cm), 25 ga
Volume: 1.5 mL at each site

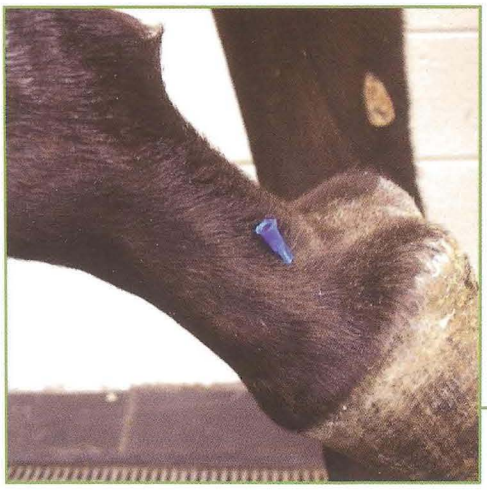


With the limb held, the **palmar digital nerve block** is performed by inserting the needle directly over the palmar aspect of the palpable neurovascular bundle about 0.4 inch (1 cm) above the collateral cartilage of the foot. Insertion of a needle at this site causes local anesthetic solution to be deposited at or slightly below the level of the caudal border of the proximal interphalangeal (pastern) joint because the height of the collateral cartilage of the foot in relation to the level of the caudal border of the pastern joint is probably similar for most horses.[9]

Insert a 5/8-inch (1.6-cm), 25-gauge needle in a distal direction, and deposit local anesthetic solution near the junction of the nerve and the collateral cartilage of the foot. By injecting local anesthetic solution as the needle is withdrawn, the solution is deposited in different tissue planes and is less likely to be administered intravascularly in either the digital artery or vein located adjacent to the nerve. Injecting as the needle is withdrawn, however, causes more proximal deposition of local anesthetic solution, which increases the likelihood of anesthetizing branches of the digital nerve that supply the pastern joint.

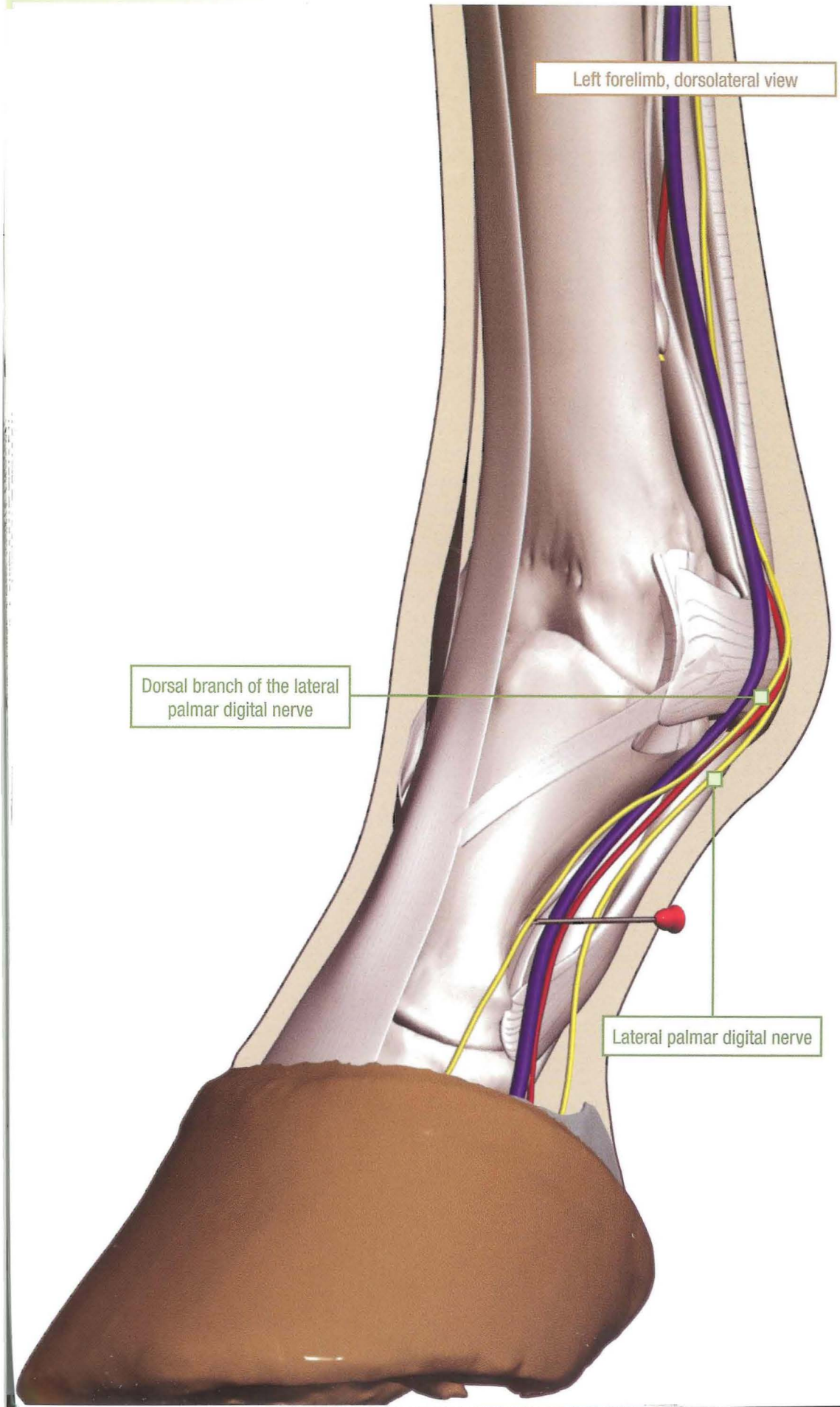
The palmar digital nerve block is sometimes referred to as the *heel block*, but anesthesia of the palmar or plantar digital nerves anesthetizes much more than the heel region of the foot. When local anesthetic solution is deposited at the recommended site (i.e., the junction of the nerve and the collateral cartilage of the foot), the following structures are desensitized: the entire sole,[10] the navicular apparatus and soft tissues of the heel,[11] the entire distal interphalangeal joint (coffin joint) of the forelimb,[12] and often, the digital portion of the deep digital flexor tendon.[13] For some horses, the pastern joint is at least partially desensitized.[9] The likelihood of desensitizing the pastern joint increases as the volume of local anesthetic solution increases and as the solution is deposited more proximally.

Resolution of lameness or loss of skin sensation at the coronary band in the palmar portion of the foot (i.e., the heel) indicates that the palmar digital nerve block was successful.

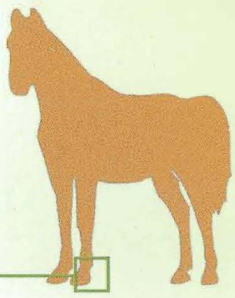


With the limb held, insert the needle directly over the palmar aspect of the palpable neurovascular bundle, about 0.4 inch (1 cm) above the collateral cartilage of the foot. *Note: Needle is in the left forelimb.*

PASTERN SEMI-RING BLOCK



Needle: 1 or 1.5 in. (2.5 or 3.8 cm), 20 to 22 ga
Volume: 2 to 3 mL on each side of the pastern



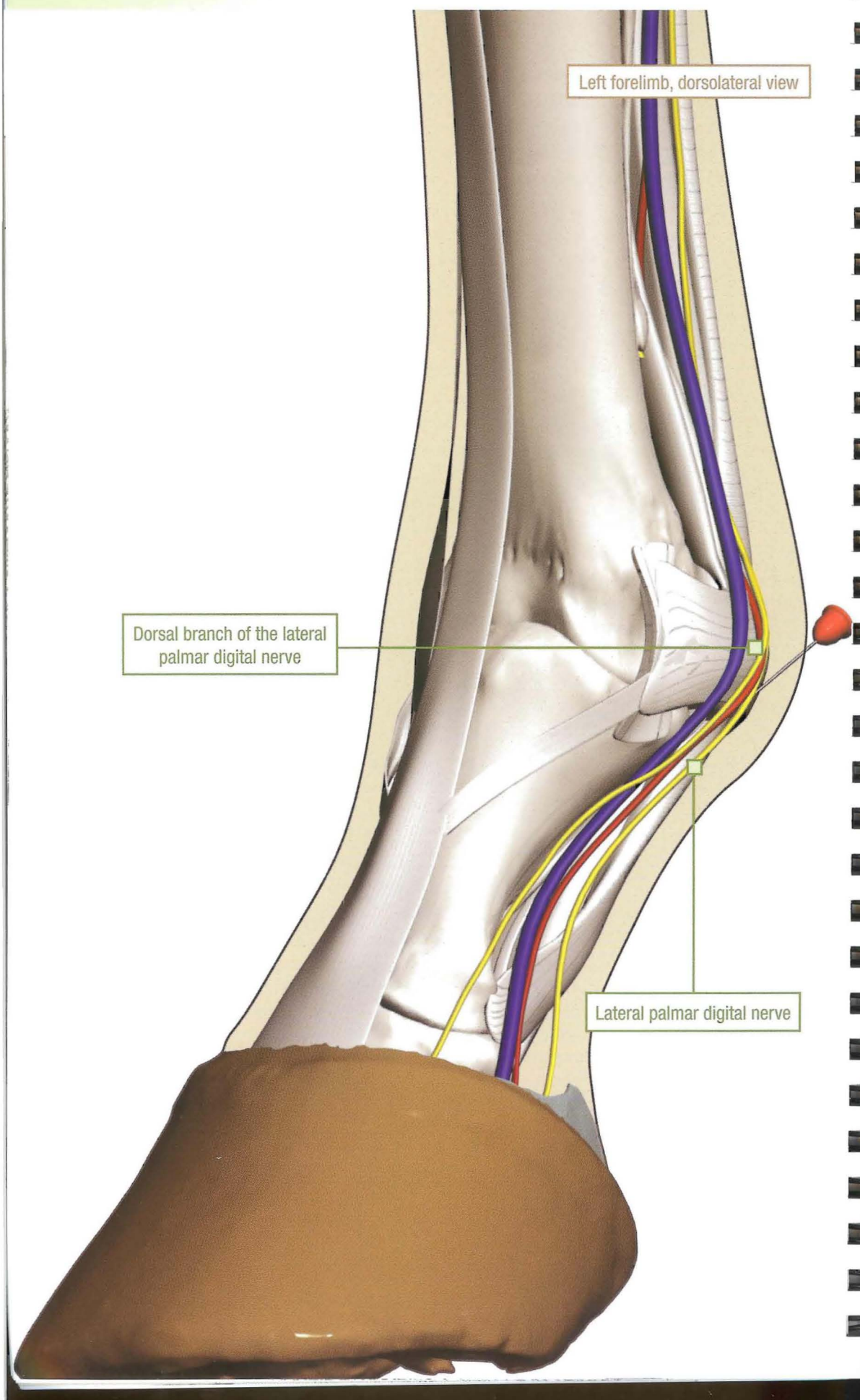
Some clinicians perform the **pastern semi-ring block** as the next analgesic technique after lack of response to a palmar digital nerve block to anesthetize the dorsal branches of the palmar digital nerves. To perform this block, insert a 20- to 22-gauge needle at the site of the previously performed palmar digital nerve block and direct it dorsally, perpendicular to the long axis of the proximal interphalangeal (pastern) joint, to deposit local anesthetic solution subcutaneously along the sides and dorsum of the pastern. Because the dorsal branches of the digital nerve contribute minimally to sensation within the foot,[12,14] the pastern semi-ring block is unlikely to ameliorate lameness that is not ameliorated with a palmar digital nerve block. However, a pastern ring block performed at mid-pastern level should be considered as an alternative to the abaxial sesamoid nerve block; the abaxial sesamoid nerve block may inadvertently partially or entirely desensitize the metacarpophalangeal joint (fetlock) in addition to the foot and pastern, which can erroneously localize pain to the foot or pastern region in horses with fetlock pain. A positive response to a ring block performed at mid-pastern level after a negative response to a palmar digital nerve block localizes lameness to the pastern region or the dorsal region of the toe.

Loss of skin sensation at the coronary band in the toe region as well as the palmar portion of the foot or heel bulbs indicates that the pastern semi-ring block was successful.

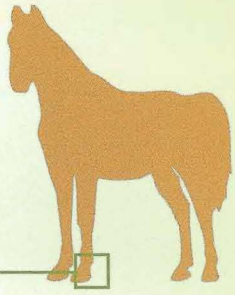
To perform a **pastern semi-ring block**, deposit local anesthetic solution subcutaneously through a needle inserted at the site of the previously performed palmar digital nerve block and direct the needle dorsally, perpendicular to the long axis of the proximal interphalangeal joint. We believe that a semi-ring block performed at this level has little value. *Note: Needle is inserted in the right forelimb.*

A **semi-ring block** performed at the level of the mid-pastern avoids amelioration of pain in the metacarpophalangeal joint that can sometimes occur with an abaxial sesamoid nerve block. *Note: Needle is in the left forelimb.*

ABAXIAL SESAMOID NERVE BLOCK



Needle: 5/8 in. (1.6 cm), 25 ga
Volume: ≤2 mL at each site



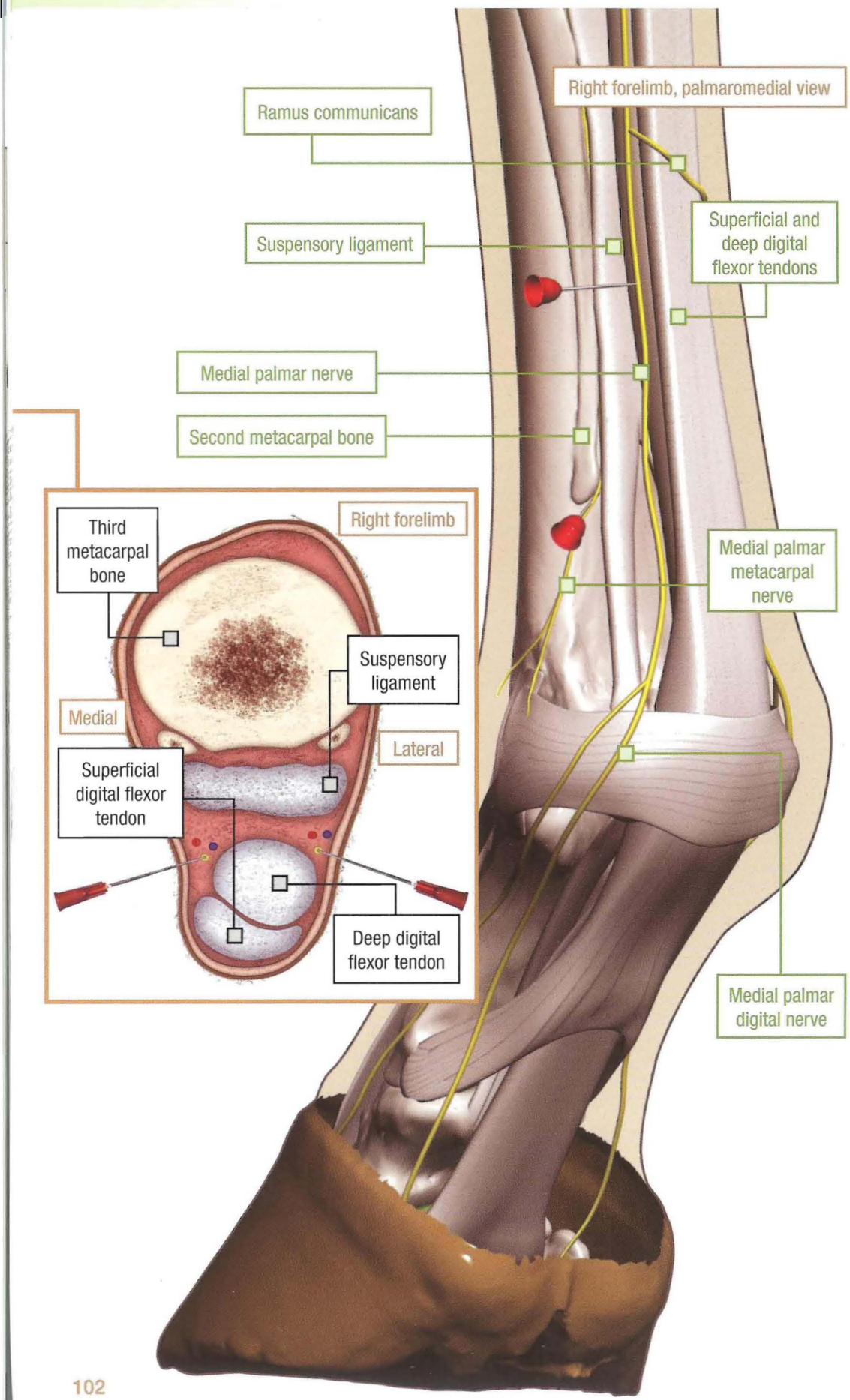
The neurovascular bundle containing the palmar digital nerve and its dorsal branch can be easily palpated along the abaxial border of each proximal sesamoid bone. The palmar digital nerves are anesthetized at this level using a 5/8-inch (1.6-cm), 25-gauge needle. To decrease the likelihood of partially desensitizing the metacarpophalangeal joint, deposit local anesthetic solution at the base of the proximal sesamoid bones (some clinicians refer to an abaxial sesamoid nerve block at this location as a *basisesamoid nerve block*)[15] using a small volume of local anesthetic solution (i.e., ≤2 mL at each site), and direct the needle distally rather than proximally.

The **abaxial sesamoid nerve block** is used to localize pain causing lameness that has not improved after anesthetizing the palmar digital nerves at the level of the cartilages of the foot (i.e., a palmar digital nerve block) or to desensitize the foot for surgery. An abaxial sesamoid nerve block desensitizes the foot, middle phalanx, proximal interphalangeal joint, distopalmar aspects of the proximal phalanx, distal portion of the superficial and deep digital flexor tendons, distal sesamoidian ligaments, and digital annular ligament.[16] The palmar portion of the metacarpophalangeal joint is sometimes desensitized.[17,18]

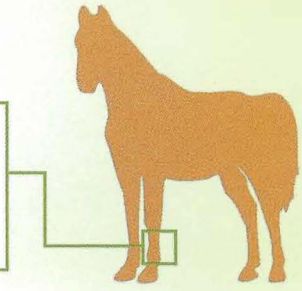
Resolution of lameness or loss of skin sensation at the coronary band in the toe region as well as the palmar portion of the foot or the heels indicates that the abaxial sesamoid nerve block was successful.

The **palmar digital nerves** are anesthetized along the abaxial border of each proximal sesamoid bone where the neurovascular bundle containing the palmar digital nerve can be easily palpated. Direct the needle distally. *Note: Needle is in the left forelimb.*

LOW PALMAR NERVE BLOCK



Needle: 5/8 in. (1.6 cm), 25 ga
Volume: 2 to 3 mL for each palmar nerve
1 mL for each palmar metacarpal nerve

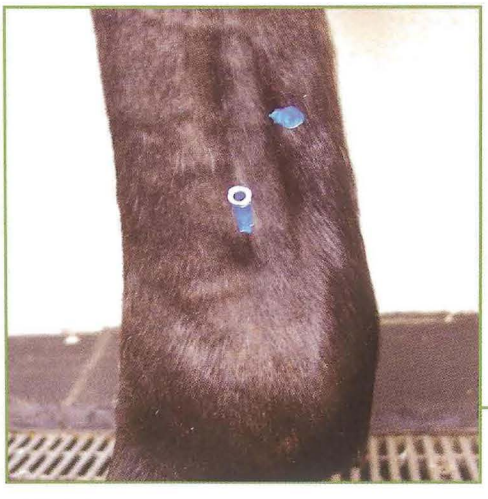


To perform a **low palmar nerve block** (low four-point block), the **medial and lateral palmar nerves** and the **medial and lateral palmar metacarpal nerves** are anesthetized at the level of the distal end of the second and fourth metacarpal bones. Because the palmar pouches of the metacarpophalangeal joint (fetlock) can be entered inadvertently when anesthetizing the palmar nerves at this level, some clinicians prefer to anesthetize the palmar nerves more proximally but below the ramus communicans that connects the palmar nerves. These nerves are usually anesthetized with the horse bearing weight on the limb. The lateral and medial palmar nerves lie between the suspensory ligament and the deep digital flexor tendon. To anesthetize them, deposit local anesthetic solution, usually about 2 mL, subcutaneously adjacent to the dorsal surface of the deep digital flexor tendon using a 5/8-inch (1.6-cm), 25-gauge needle.

The medial and lateral palmar metacarpal nerves lie between the palmar surface of the third metacarpal bone and the axial surface of either the second or fourth metacarpal bone. To anesthetize them, use a 5/8-inch (1.6-cm), 25-gauge needle to deposit local anesthetic solution, usually 1 mL, next to the periosteum beneath the distal end of each small metacarpal bone where the nerve emerges.

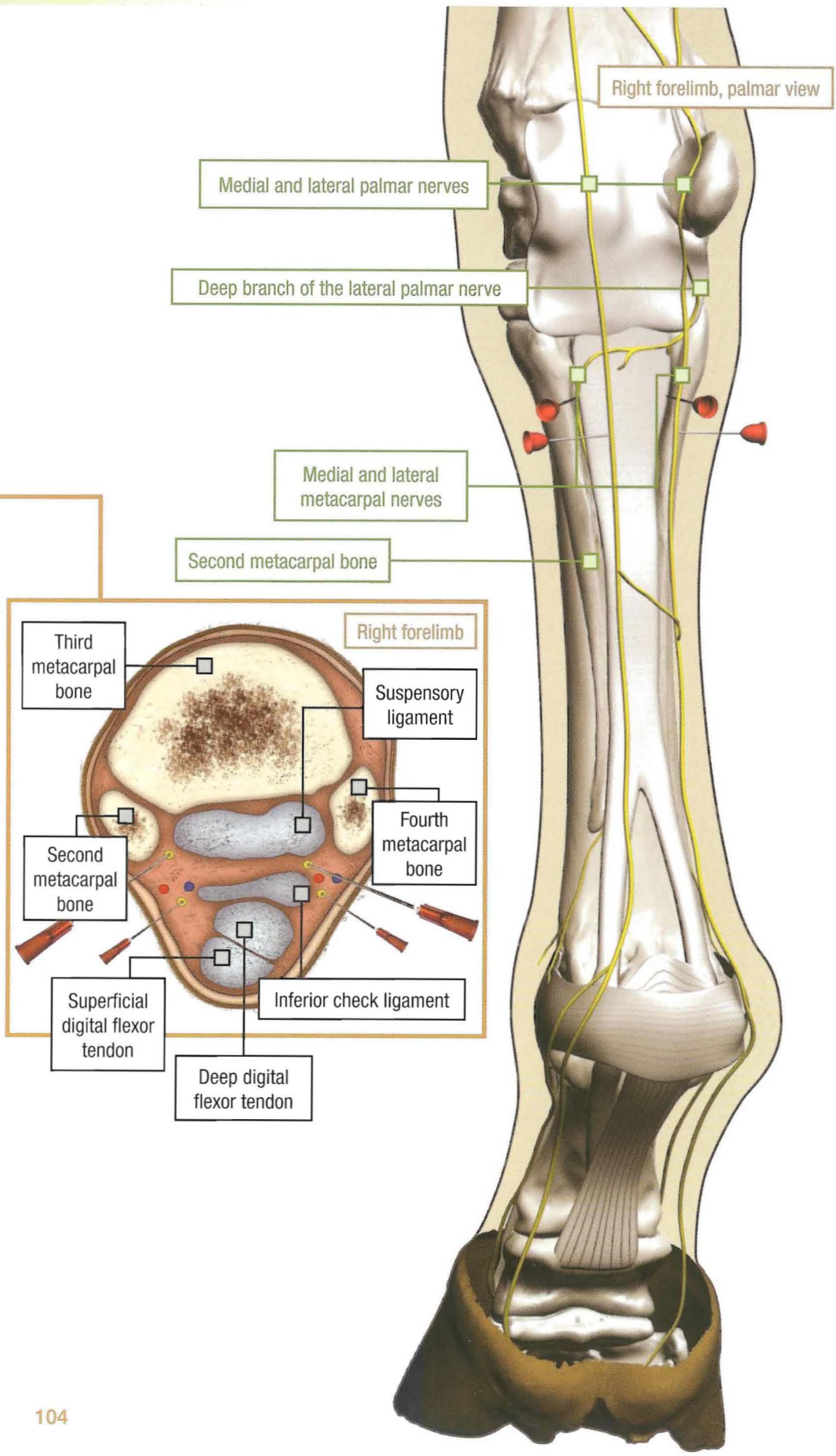
The low palmar nerve block is used to localize pain that is causing lameness that has not improved after anesthetizing the palmar digital nerves at the level of the base of the proximal sesamoid bones or to desensitize the foot or pastern region for surgery. By anesthetizing these four nerves, the fetlock and structures distal to it are desensitized. The superficial and deep digital flexor tendons below this region are desensitized as well as the distal aspect of the branches of the suspensory apparatus.[17] Proximal diffusion of local anesthetic solution to the extent that pain in the proximal metacarpal region would be abolished is unlikely.[1]

Inadvertent and unrecognized injection of the deep digital flexor tendon sheath can occasionally occur when performing this block.[1] Anesthesia of skin over the dorsal aspect of the proximal phalanx and the fetlock indicates that the low palmar nerve block was successful. The horse may retain some cutaneous sensation over the dorsal aspect of the fetlock as a result of sensory innervation from a branch of the medial cutaneous antebrachial nerve.

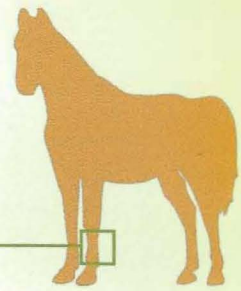


To perform the **low palmar nerve block** (low four-point block), anesthetize the medial and lateral palmar metacarpal nerves at the level of the distal end of the second and fourth metacarpal bones. Because the palmar pouches of the fetlock joint can be inadvertently entered when anesthetizing the palmar nerves at this level, these nerves are sometimes anesthetized more proximally. *Note: Needles are inserted in the right forelimb.*

HIGH PALMAR NERVE BLOCK



Needles: ⅝ in. (1.6 cm), 25 ga and 1.5 in. (3.8 cm), 20 to 22 ga
Volume: 2 to 3 mL at each site



With the **high palmar nerve block** (high four-point block), the **medial and lateral palmar nerves** and the **medial and lateral palmar metacarpal nerves** are anesthetized slightly distal to the level of the carpometacarpal joint. To anesthetize each palmar nerve in this location, deposit 2 to 3 mL of local anesthetic solution through a ⅝-inch (1.6-cm), 25-gauge needle inserted through heavy fascia to where the palmar nerve lies adjacent to the dorsal surface of the deep digital flexor tendon. The palmar nerves are usually anesthetized in this location with the horse bearing weight on the limb.

The medial and lateral palmar metacarpal nerves are anesthetized slightly below the carpometacarpal joint where the nerves lie between the palmar surface of the third metacarpal bone and the axial surface of the second or fourth metacarpal bones. Deposit local anesthetic solution, usually about 2 to 3 mL, at each site using a 1.5-inch (3.8-cm), 20- to 22-gauge needle. The palmar metacarpal nerves are usually anesthetized in this location with the limb held.

The high palmar nerve block is sometimes the next block used to localize lameness that has not improved after the low palmar nerve block. Anesthetizing the medial and lateral palmar nerves alone slightly below the carpometacarpal joint desensitizes the flexor tendons. Anesthetizing the palmar metacarpal nerves alone at this level desensitizes the second and fourth metacarpal bones, their interosseous ligaments and, the proximal portion of the suspensory ligament. The high palmar nerve block desensitizes the inferior check ligament.

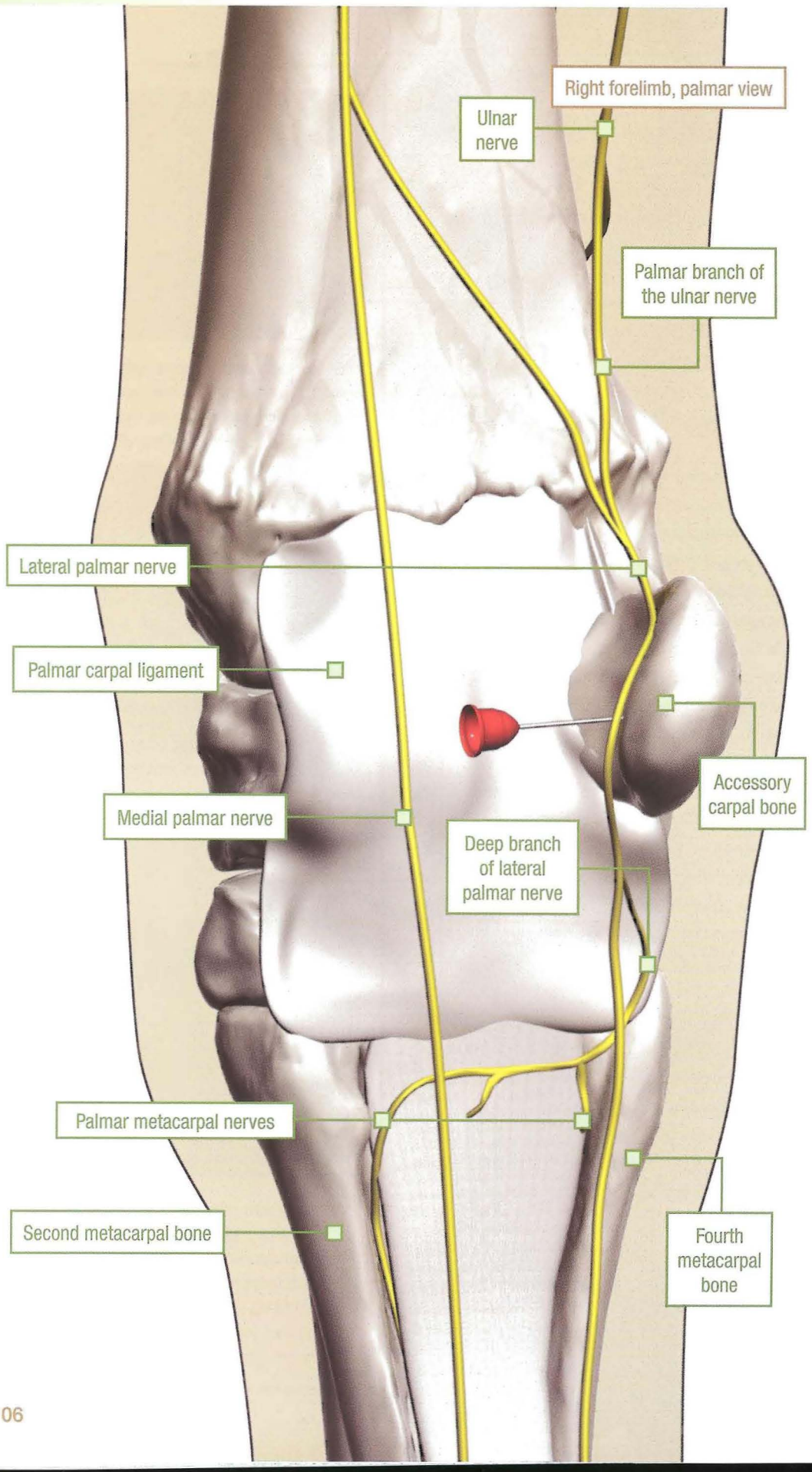
Anesthesia of skin over the palmar aspect of the metacarpus indicates that the high palmar nerve block was successful.

With the **high palmar nerve block** (high four-point block), the **palmar and palmar metacarpal nerves** are anesthetized slightly distal to the level of the carpometacarpal joint. *Note: Needle is in the left forelimb.*

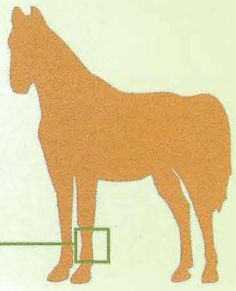
To anesthetize each **palmar nerve** slightly distal to the level of the carpometacarpal joint, insert a needle through heavy fascia to where the palmar nerve lies adjacent to the dorsal surface of the deep digital flexor tendon. The palmar nerves are usually anesthetized in this location with the horse bearing weight on the limb. *Note: Needle is in the right forelimb.*

The **medial and lateral palmar metacarpal nerves** are anesthetized slightly distal to the carpometacarpal joint where the nerves lie between the palmar surface of the third metacarpal bone and the axial surface of the second or fourth metacarpal bone. The palmar metacarpal nerves are usually anesthetized in this location with the limb held. *Note: Needle is in the right forelimb.*

LATERAL PALMAR NERVE BLOCK



Needle: 1 in. (2.5 cm), 20 to 22 ga or 5/8 in. (1.6 cm), 25 ga
Volume: 5 mL or 1.5 to 2 mL



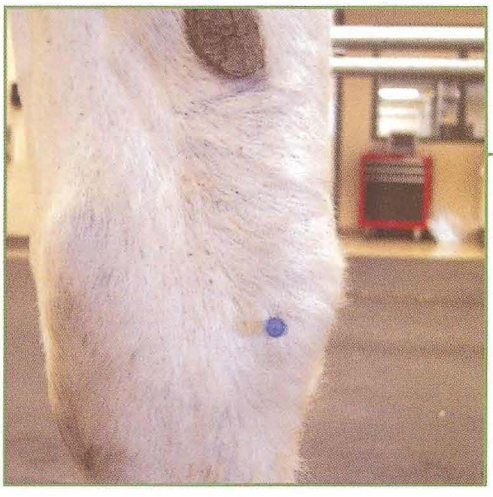
The origin of the suspensory ligament and the proximal end of the second and fourth metacarpal bones can be desensitized by anesthetizing the **lateral palmar nerve** at the level of the middle carpal joint, before its deep branch innervates these structures. The lateral palmar nerve originates proximal to the carpus and is formed by the lateral palmar branch of the median nerve and the palmar branch of the ulnar nerve. The lateral palmar nerve has a deep branch, which innervates the origin of the suspensory ligament and divides into the lateral and medial palmar metacarpal nerves at the level of the proximal end of the fourth metacarpal bone.

The lateral palmar nerve can be anesthetized as it courses distal to the accessory carpal bone close to the accessoriometacarpal ligament. The site of injection is located on the palmar border of this ligament midway between the ligament's insertion on the distal aspect of the accessory carpal bone and the proximal aspect of the fourth metacarpal bone. The nerve is anesthetized, usually with the horse bearing weight on the limb, with 5 mL of local anesthetic solution administered through a 1-inch (2.5-cm), 20- to 22-gauge needle, which must penetrate the thick flexor carpal retinaculum.

This injection technique results in a high incidence of penetration of the carpal canal; if the volume of anesthetic solution deposited within the carpal canal is sufficient to ameliorate pain associated with disease of the structures contained within this synovial cavity, anesthesia of the lateral palmar nerve using this technique may lead to erroneous interpretations. Although the site of injection is close to the distal aspect of the carpus, inadvertent infiltration of local anesthetic solution into the carpometacarpal and intercarpal joints using this technique is unlikely.[19]

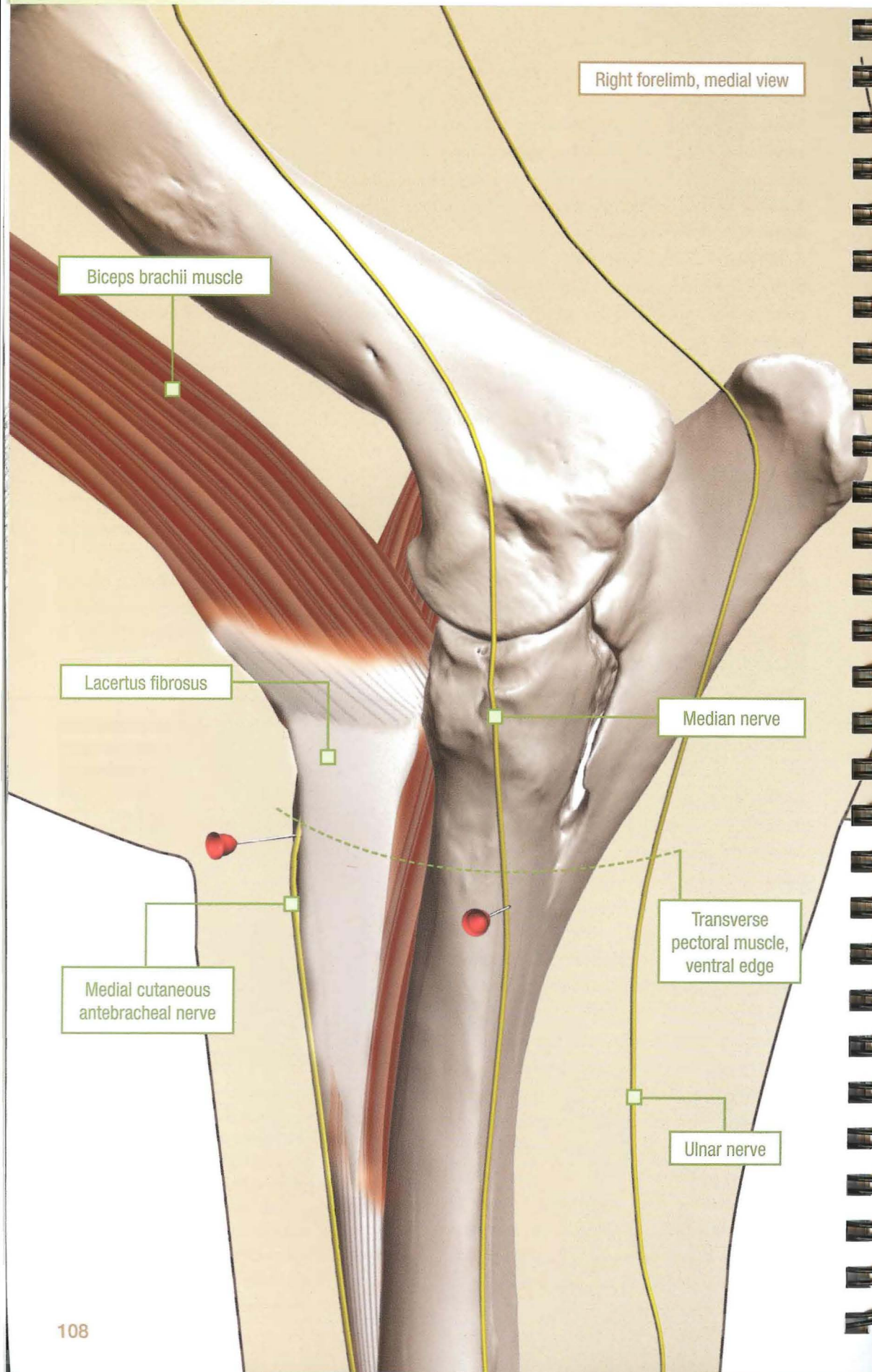
Alternatively, the lateral palmar nerve can be most easily and accurately anesthetized where it courses along the medial aspect of the accessory carpal bone.[20] At this level, the lateral palmar nerve lies adjacent to the medial aspect of the accessory carpal bone, together with the lateral palmar vein and artery. The site of injection is a longitudinal groove in the fascia that can be palpated over the medial aspect of the accessory carpal bone, palmar to the insertion of the flexor retinaculum that forms the palmaromedial aspect of the carpal canal. With the horse bearing weight on the limb, insert a 5/8-inch (1.6-cm), 25-gauge needle into the distal third of the groove in a mediolateral direction. When the point of the needle contacts the medial aspect of the accessory carpal bone, inject 1.5 to 2 mL of local anesthetic solution. This technique of anesthetizing the lateral palmar nerve avoids inadvertent deposition of the local anesthetic solution into the carpal canal. Testing for loss of skin sensation is not useful in evaluating the effect of this block.

Amelioration of lameness after anesthesia of the lateral palmer nerve alone at this location incriminates the proximal portion of the suspensory ligament as the site of pain causing lameness, provided that sites distal to the proximal aspect of the suspensory ligament have been eliminated using a low palmar nerve block. Anesthetizing the medial palmer nerve at the level of the proximal aspect of the metacarpus in conjunction with anesthesia of the lateral palmar nerve provides extensive desensitization of the distal portion of the limb.

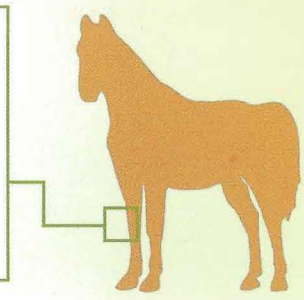


The **lateral palmar nerve** can be anesthetized most easily and accurately where it courses along the medial aspect of the accessory carpal bone. With the horse bearing weight on the limb, insert a 5/8-inch (1.6-cm), 25-gauge needle in a mediolateral direction into the distal third of the longitudinal groove, which can be palpated over the medial aspect of the accessory carpal bone. When the point of the needle contacts bone, inject local anesthetic solution. *Note: Needle is in the right forelimb.*

MEDIAN, MEDIAL CUTANEOUS ANTEBRACHIAL, AND ULNAR NERVES



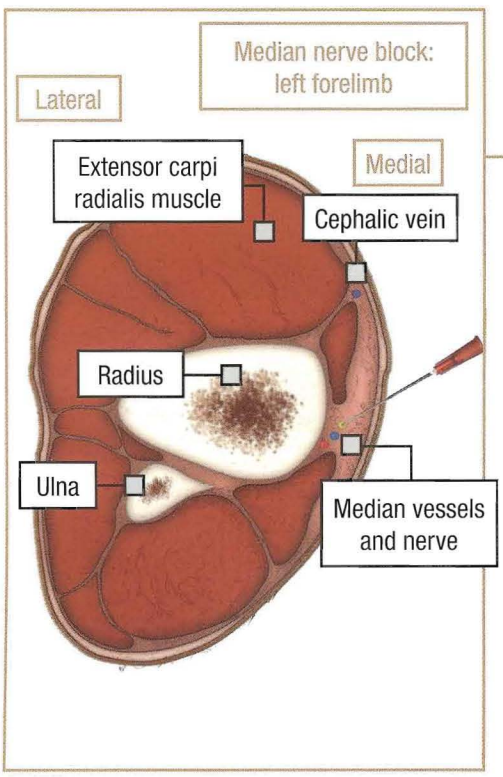
Needle: Median nerve–2 to 2.5 in. (5 to 6.4 cm), 20 ga
Medial cutaneous antebrachial nerve—
⅝ in. (1.6 cm), 25 ga
Volume: Median nerve–10 mL
Medial cutaneous antebrachial nerve—5 mL at each site



The carpus and distal aspect of the limb can be desensitized by anesthetizing the median, medial cutaneous antebrachial and ulnar nerves. Although these nerves are sometimes anesthetized for diagnostic purposes, they are most commonly anesthetized to desensitize the distal portion of the limb for surgery.

The **median nerve** is anesthetized on the caudomedial aspect of the radius just below the cubital joint (elbow), where the ventral edge of the transverse pectoral muscle inserts on the radius. Insert a 2- to 2.5-inch (5- to 6.4-cm), 20-gauge needle at this site, and direct it proximally and laterally through the fascia close to the caudal surface of the radius to a depth of 1 to 2 inches (2.5 to 5 cm). Advance the needle close to the radius to avoid the median vein and artery, and deposit about 10 mL of local anesthetic solution. Anesthesia of the median nerve alone partially desensitizes the carpus, distal aspect of the antebrachium, and structures innervated by the medial and lateral palmar nerves. Loss of skin sensation on the craniomedial aspect of the pastern indicates a successful median nerve block.[5]

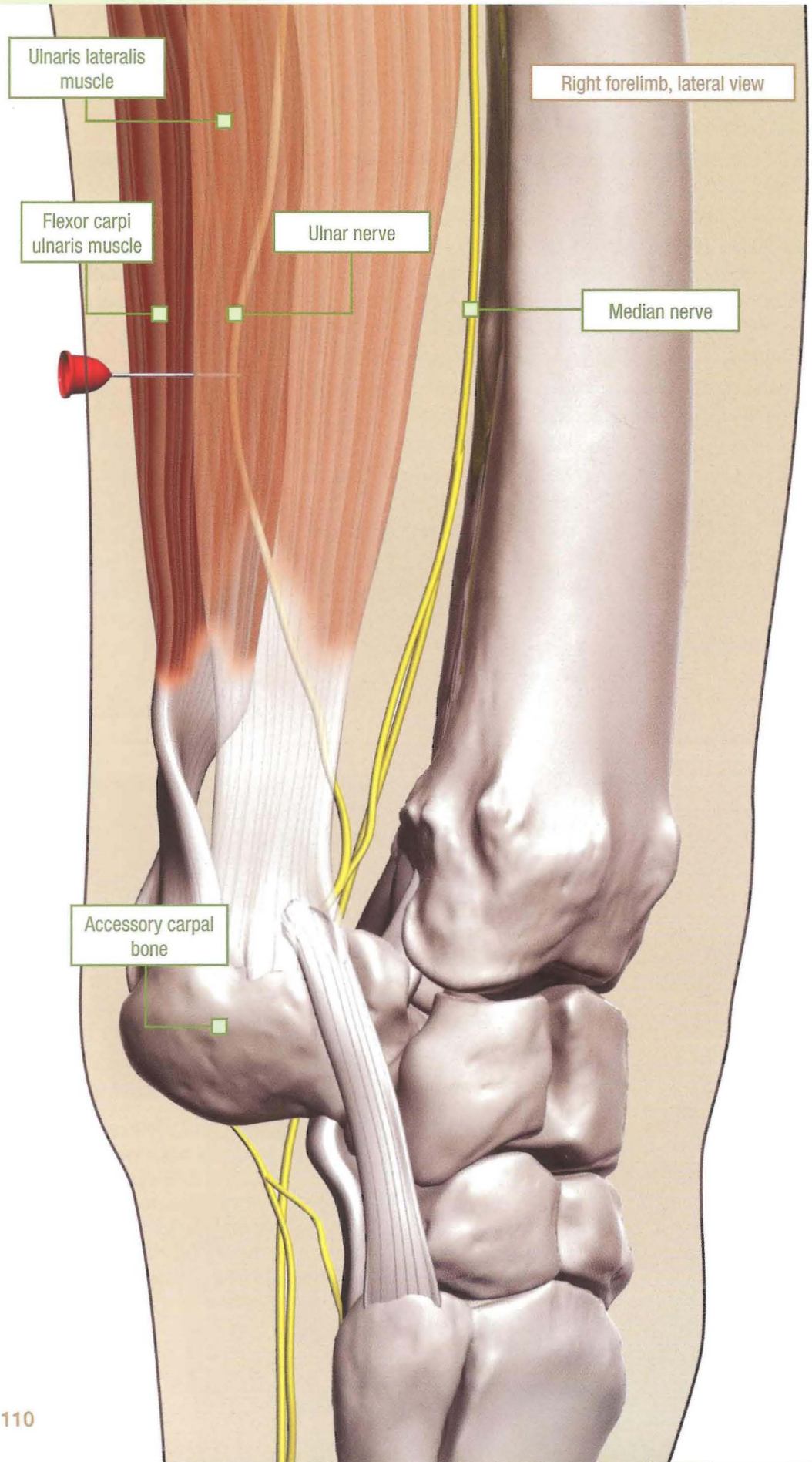
The **medial cutaneous antebrachial nerve**, a branch of the musculocutaneous nerve, can be anesthetized below the dorsal aspect of the elbow joint, where it can be palpated as it crosses the lacertus fibrosus. Distal to the lacertus fibrosus on the medial aspect of the forelimb, the medial cutaneous antebrachial nerve forms two branches, which can be anesthetized on the medial aspect of the radius halfway between the elbow and the carpus (i.e., about 4 inches [10 cm] proximal to the chestnut). One branch lies on the cranial aspect of the cephalic vein, and the other branch lies on the cranial aspect of the accessory cephalic vein. Because the location of these branches can vary, infiltrate local anesthetic solution subcutaneously both cranially and caudally to the cephalic and accessory cephalic veins using a ⅝-inch (1.6-cm), 25-gauge needle.[7] Infiltration of 5 mL of anesthetic solution at each site is usually sufficient. This block desensitizes the skin on the dorsal and medial aspects of the metacarpus.



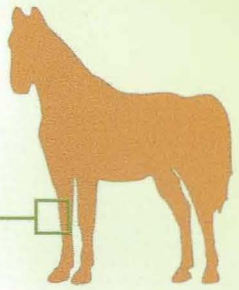
The **median nerve** is anesthetized where the ventral edge of the transverse pectoral muscle inserts on the radius. Insert a 2- to 2.5-inch (5- to 6.4-cm), 20-gauge needle at this site, and direct it proximally and laterally through the fascia close to the caudal surface of the radius to a depth of 1 to 2 inches (2.5 to 5 cm). Advance the needle close to the radius to avoid the median vein and artery. *Note: Needle is in the left forelimb.*

MEDIAN, MEDIAL CUTANEOUS ANTEBRACHIAL, AND ULNAR NERVES

CONTINUED



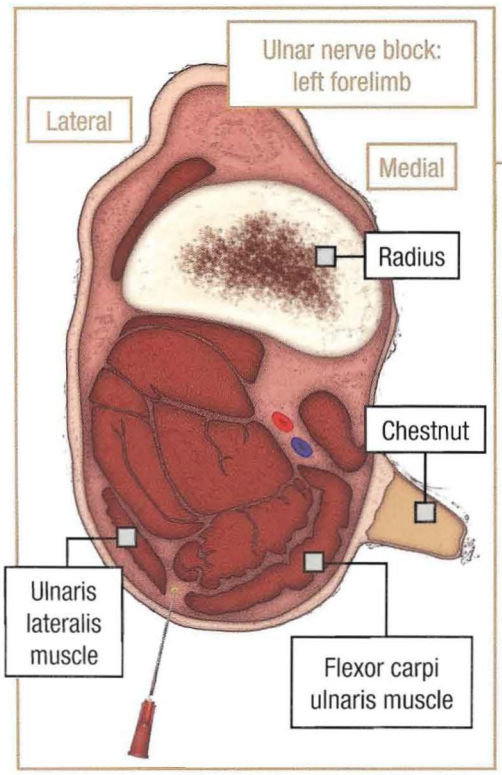
Needle: Ulnar nerve—1 in. (2.5 cm), 20 ga
Volume: Ulnar nerve—10 mL



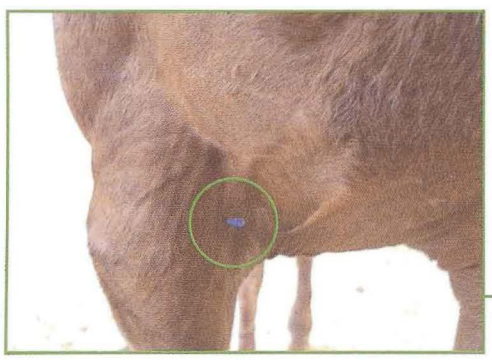
The **ulnar nerve** is anesthetized about 4 inches (10 cm) proximal to the accessory carpal bone, at which point the nerve lies about 0.25 to 0.5 inch (0.6 to 1.3 cm) below the surface of the skin under the superficial fascia in the groove between the ulnaris lateralis and the flexor carpi ulnaris muscles. In this region, infuse about 10 mL of local anesthetic solution superficially and deeply through a 1-inch (2.5-cm), 20-gauge needle.

Loss of skin sensation on the craniolateral aspect of the metacarpus indicates a successful ulnar nerve block.[5] Lameness caused by lesions of the accessory carpal bone and surrounding structures, the second and fourth metacarpal bones and their interosseous ligaments, and the suspensory ligament is partially ameliorated by anesthetizing the ulnar nerve.

Concurrent anesthesia of both the median and ulnar nerves desensitizes most structures distal to the blocks that might be involved in lameness. Because the medial cutaneous antebrachial nerve innervates only the skin, anesthesia of this nerve is not a necessary part of a lameness examination.[8]

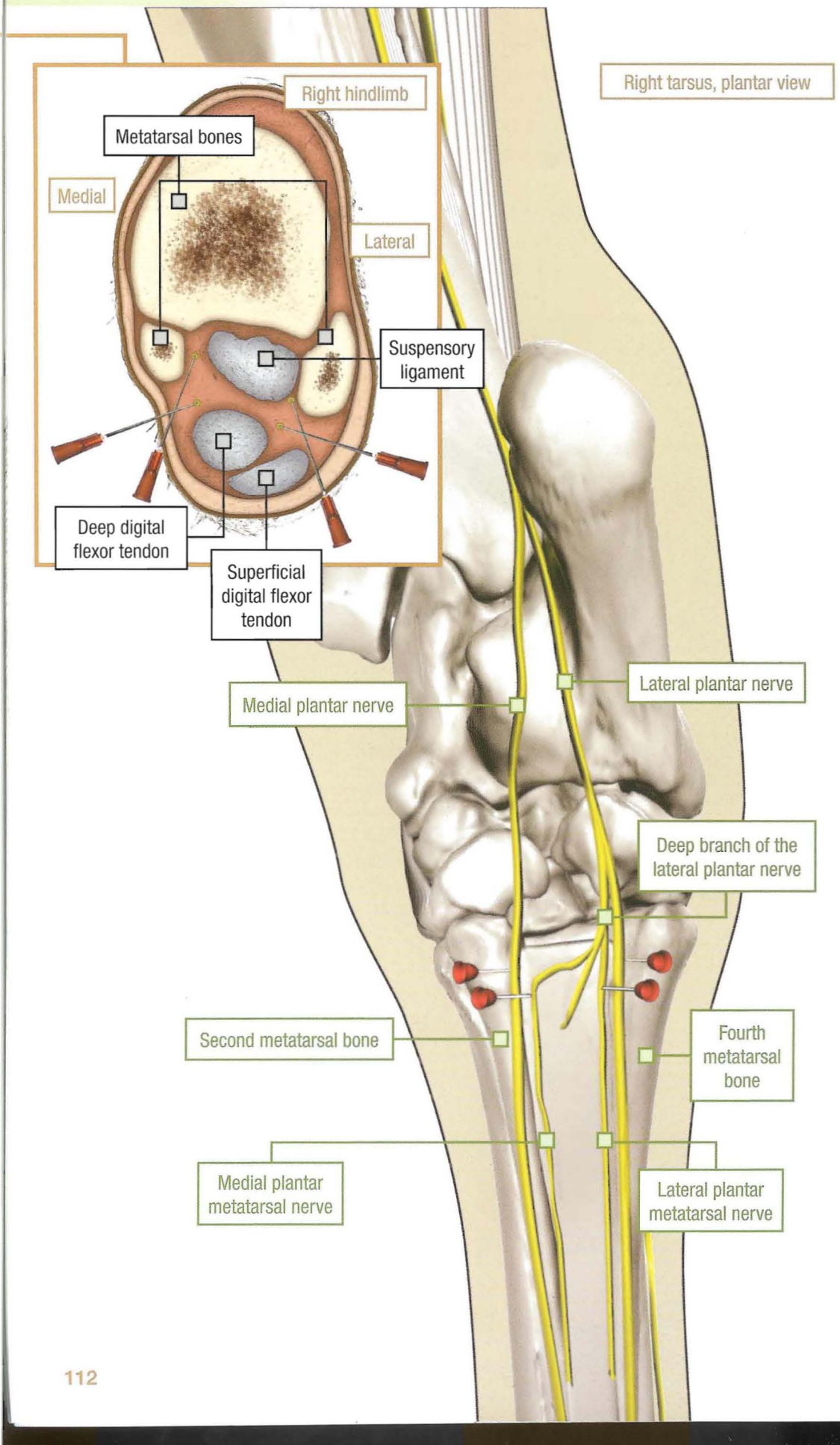


The **ulnar nerve** is anesthetized about 4 inches (10 cm) above the accessory carpal bone, at which point the nerve lies about 0.25 to 0.5 inch (0.6 to 1.3 cm) below the surface of the skin under the superficial fascia in the groove between the ulnaris lateralis and the flexor carpi ulnaris muscles. *Note: Needle is in the left forelimb.*

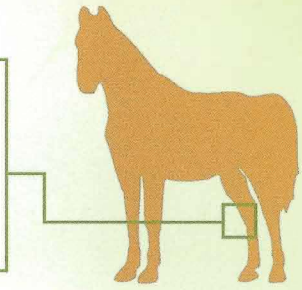


The **medial cutaneous antebrachial nerve** can be anesthetized immediately proximal to the dorsal aspect of the cubital joint (elbow) (*circled area*) where it can be palpated as it crosses the lacertus fibrosus. *Note: Needle is in the right forelimb.*

HIGH PLANTAR NERVE BLOCK



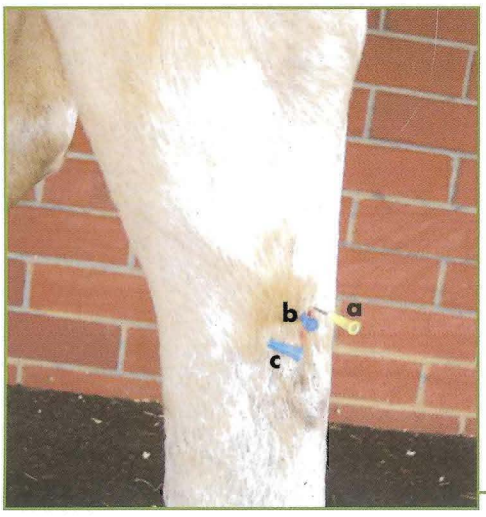
Needle: Plantar metatarsal nerve—1.5 in. (3.8 cm), 20 to 22 ga
Plantar nerve—⅝ in. (1.6 cm), 25 ga
Volume: 2 to 3 mL at each site



With the **high plantar nerve block** (high six-point block), anesthesia of the **medial and lateral plantar nerves**, the **medial and lateral plantar metatarsal nerves**, and the **dorsal metatarsal nerves** just distal to the tarsometatarsal joint provides complete analgesia to structures in the metatarsal region and below. To anesthetize the **plantar metatarsal nerves** in this region, insert a 1.5-inch (3.8-cm), 20- to 22-gauge needle about 0.4 inch (1 cm) distal to the tarsometatarsal joint and axial to the second or fourth metatarsal bone until its point contacts the third metacarpal bone. Deposit 2 to 3 mL of local anesthetic solution at this location. The plantar metatarsal nerves are usually anesthetized in this location with the horse bearing weight on the limb. Anesthetizing both plantar metatarsal nerves alone at this level desensitizes the second and fourth metatarsal bones and their interosseous ligaments as well as the proximal portion of the suspensory ligament. Although not likely, local anesthetic solution could be inadvertently placed in the tarsometatarsal joint with this block. Inadvertent administration of local anesthetic solution into the tarsal sheath is likely when blocking the plantar metatarsal nerves.[21]

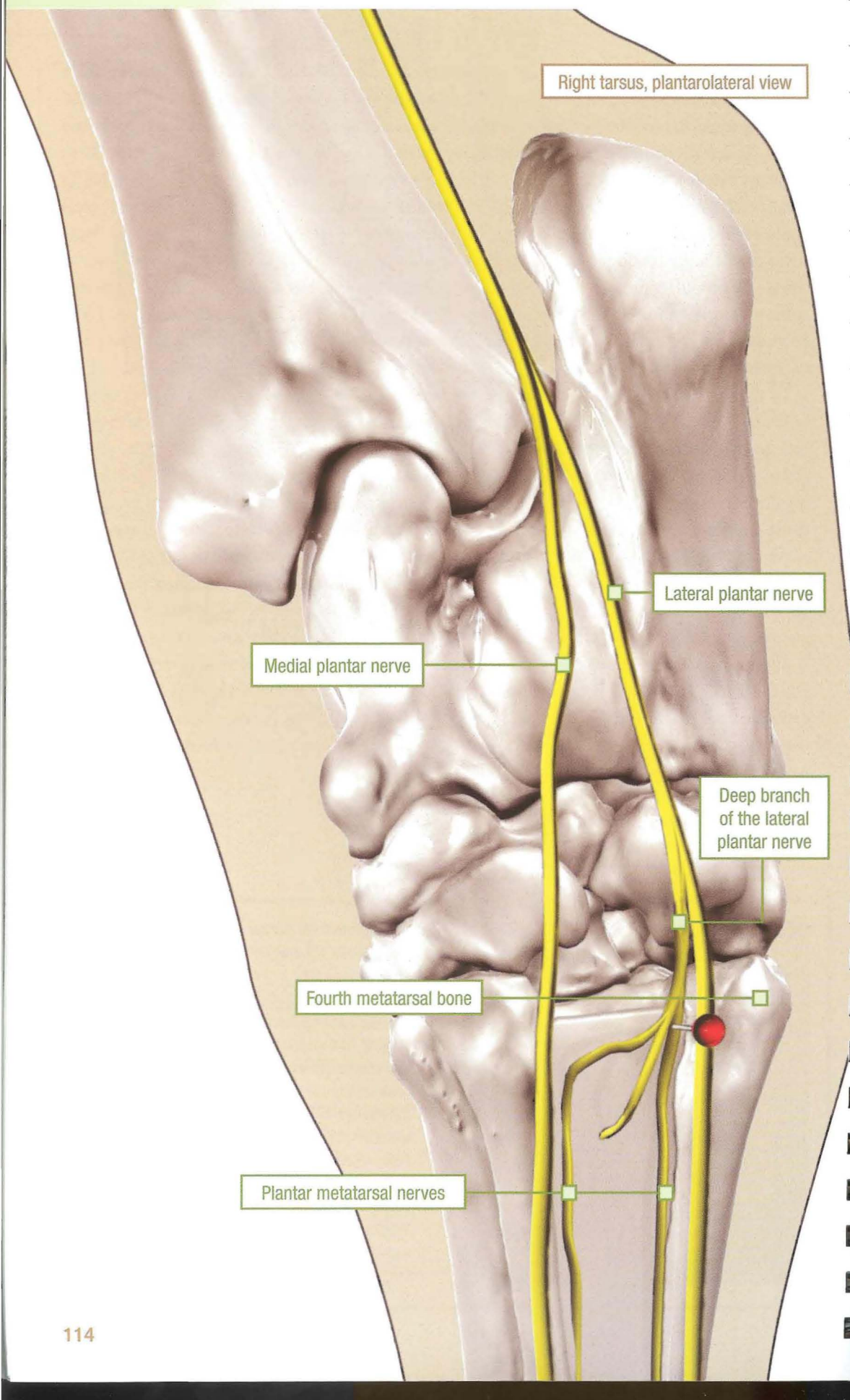
To anesthetize the **medial and lateral plantar nerves** in this location, deposit 2 to 3 mL of local anesthetic solution through a ⅝-inch (1.6-cm), 25-gauge needle inserted through heavy fascia to where each plantar nerve lies adjacent to the dorsal surface of the deep digital flexor tendon. The plantar nerves are usually anesthetized in this location with the horse bearing weight on the limb. Anesthetizing the **lateral plantar nerve** at this level, especially if a large volume (e.g., 7 to 10 mL) of local anesthetic solution is used, is likely to anesthetize its deep branch, which divides into the medial and lateral plantar metatarsal nerves, making it unnecessary to block the plantar metatarsal nerves individually. Anesthetizing the lateral plantar nerve alone at this level desensitizes the same structures that are desensitized by anesthesia of the medial and lateral plantar metatarsal nerves. Anesthesia of the lateral plantar nerve is assessed by testing for a lack of skin sensation over the plantar aspect of the metatarsus.

All but the proximodorsal aspect of the limb distal to the tarsometatarsal joint is desensitized by anesthetizing the medial and lateral plantar nerves and the plantar metatarsal nerves. Subcutaneous deposition of 2 mL of local anesthetic solution at the dorsomedial and the dorsolateral aspect of the metatarsus at this level though a ⅝-inch (1.6-cm), 25-gauge needle anesthetizes the **dorsal metatarsal nerves** and completes the high plantar block.

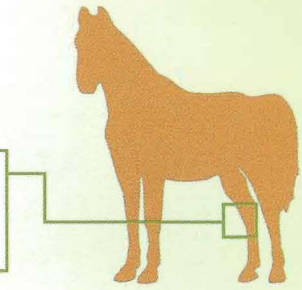


To anesthetize the **plantar metatarsal nerves** in this region, insert a 1.5-inch (3.8-cm), 20- to 22-gauge needle (**a**) about 0.4 inch (1 cm) distal to the tarsometatarsal joint and axial to the second or fourth metatarsal bone until its point contacts the third metacarpal bone and deposit 2 to 3 mL of local anesthetic solution. For the **medial and lateral plantar nerves**, deposit 2 to 3 mL of local anesthetic solution through a ⅝-inch (1.6-cm), 25-gauge needle (**b**) inserted through heavy fascia to where each plantar nerve lies adjacent to the dorsal surface of the deep digital flexor tendon. Subcutaneous deposition of 2 mL of local anesthetic solution at the dorsomedial and the dorsolateral aspects of the metatarsus at this level (**c**) anesthetizes the **dorsal metatarsal nerves** and completes the high plantar block. *Note: Needles are in the left hindlimb.*

DEEP BRANCH OF THE LATERAL PLANTAR NERVE

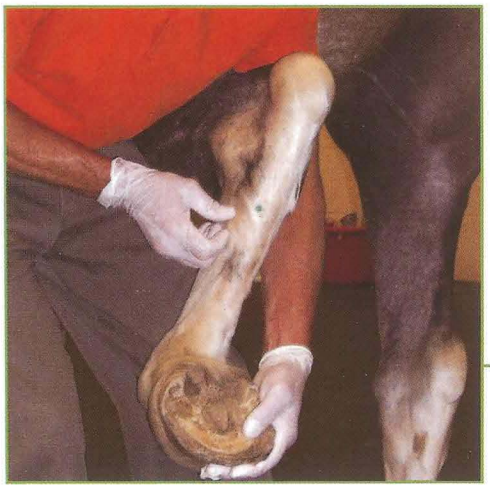


Needle: 1 in. (2.5 cm), 23 ga
Volume: 5 mL



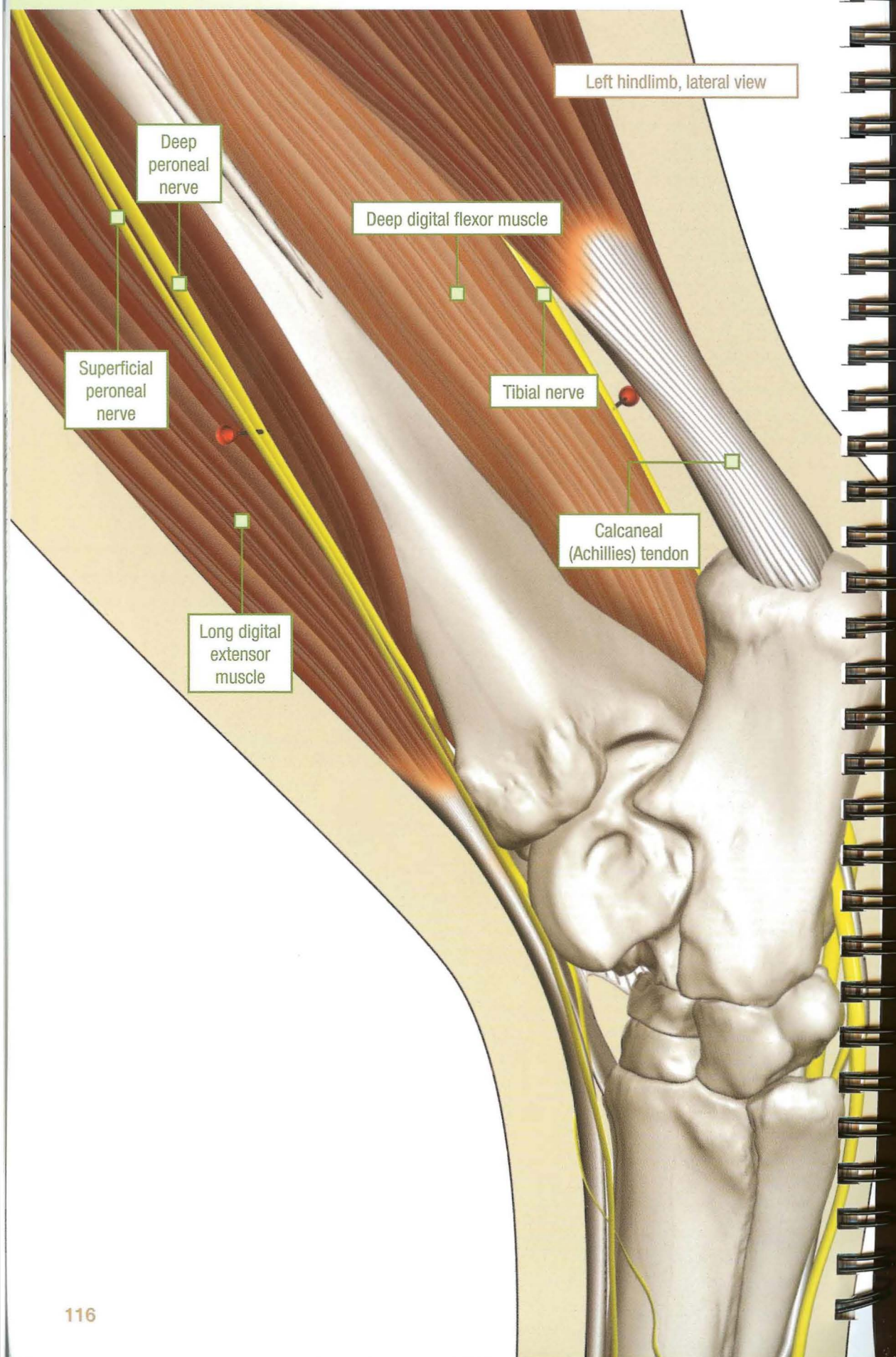
The **deep branch of the lateral plantar nerve** (DBLPN) is anesthetized to aid in the diagnosis of proximal suspensory desmitis. Several techniques for blocking the DBLPN have been described.[22–24] We prefer the technique described by Hughes et al.[24] The DBLPN is anesthetized ⅝ inch (1.6 cm) below the head of the fourth metatarsal bone (splint bone). The hock is placed on the clinician's thigh with the hock and stifle flexed at a 90° angle and the distal portion of the limb held in a fully flexed position. Using the free hand, the superficial digital flexor tendon is deflected medially and the needle is inserted perpendicular to the skin surface on the plantarolateral surface of the metatarsus. The needle is advanced between the lateral splint bone and the lateral border of the superficial digital flexor tendon to its hub. This approach is very reliable for depositing local anesthetic solution proximal to the DBLPN.

Depositing 5 mL of local anesthetic solution at this site is likely to anesthetize the lateral plantar nerve and the DBLPN, and subsequently the medial and lateral plantar metatarsal nerves, which are branches of the DBLPN. Therefore, performing this block using at least 5 mL local anesthetic solution probably anesthetizes the same structures as the high plantar block. Unlike the high plantar block, however, this block is unlikely to result in penetration of the tarsal sheath or the tarsometatarsal joint as described by Dyson and Romero.[21] To rule out pain in the distal portion of the limb as a cause of lameness, a low plantar block should be performed before anesthetizing the DBLPN.

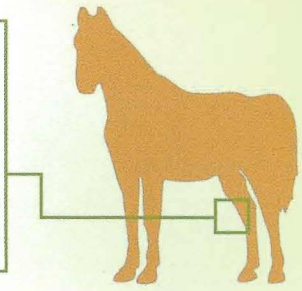


The **deep branch of the lateral plantar nerve** (DBLPN) is anesthetized ⅝ inch (1.6 cm) below the head of the fourth metatarsal bone. The hock is placed on the clinician's thigh with the hock and stifle flexed at a 90° angle and the distal portion of the limb held in a fully flexed position. Using the free hand, the superficial digital flexor tendon is deflected medially and the needle is inserted perpendicular to the skin surface on the plantarolateral surface of the metatarsus. *Note: Needle is in the left hindlimb.*

TIBIAL AND DEEP AND SUPERFICIAL PERONEAL (FIBULAR) NERVES

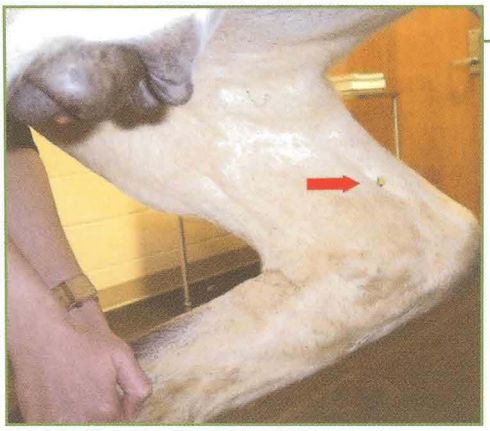


Needle: Tibial nerve—1.5 in. (3.8 cm), 20 to 22 ga
Peroneal nerves—1.5 to 2 in. (3.8 to 5 cm), 20 to 22 ga
Volume: Tibial nerve—15 to 20 mL
Peroneal nerves—Total of 20 mL

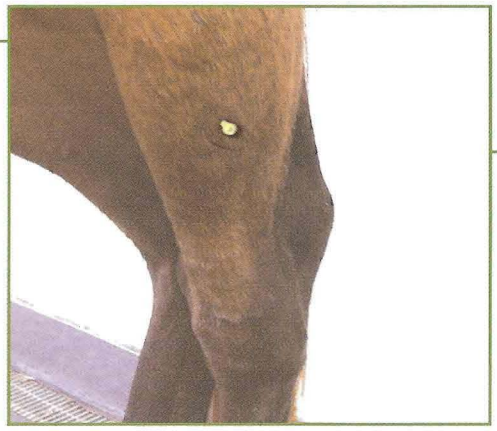


Anesthetizing the **tibial and deep and superficial peroneal (fibular) nerves** above the point of the hock desensitizes the entire distal portion of the limb. The **tibial nerve** is anesthetized approximately 4 inches (10 cm) above the point of the hock on the medial aspect of the limb, where it can be palpated on the caudal surface of the deep digital flexor muscle, cranial to the calcaneal (Achillies) tendon. The nerve can be palpated at this level only while the limb is flexed. Rarely, a horse may react violently to needle placement, presumably because of contact of the needle with the nerve. To anesthetize this nerve, deposit 15 to 20 mL of local anesthetic solution at this site in at least several planes in the fascia that overlies the deep digital flexor muscle through a 1.5-inch (3.8-cm), 20- to 22-gauge needle. Failure to block the nerve is common even though the nerve lies superficially. The needle must penetrate the deep crural fascia between the subcutis and nerve, because subcutaneous injection of local anesthetic solution does not anesthetize the tibial nerve.[25] Amelioration of lameness after the tibial nerve has been anesthetized incriminates the suspensory ligament as a site of pain, provided that more distal structures of the limb have been eliminated as a source of pain using a low plantar nerve block. Anesthesia of the tibial nerve alone can be tested by finding a loss of skin sensation between the bulbs of the heel,[17] but loss of cutaneous sensation is variable.[5]

To completely desensitize the hock and the limb distal to the hock, the **deep and superficial peroneal (fibular) nerves** must also be anesthetized. The site at which these peroneal nerves are usually anesthetized is on the lateral aspect of the limb about 4 inches (10 cm) above the point of the hock in the groove formed by the lateral and long digital extensor muscles. To anesthetize the deep peroneal nerve, insert a 1.5- to 2-inch (3.8- to 5-cm), 20- to 22-gauge needle into the groove, direct it slightly caudally until it contacts the caudal edge of the tibia, and deposit 10 mL of local anesthetic solution; to anesthetize the superficial peroneal nerve, deposit another 10 mL superficially in three or four planes as the needle is withdrawn. The horse may drag the toe of the desensitized limb or stumble when the deep peroneal nerve or the more proximal common peroneal nerve is anesthetized. Loss of skin sensation is inconsistent but likely over the dorsolateral aspect of hock and metatarsus.[5,17,26] The horse may drag its toe as an indication that the nerve is blocked, but this also is inconsistant.

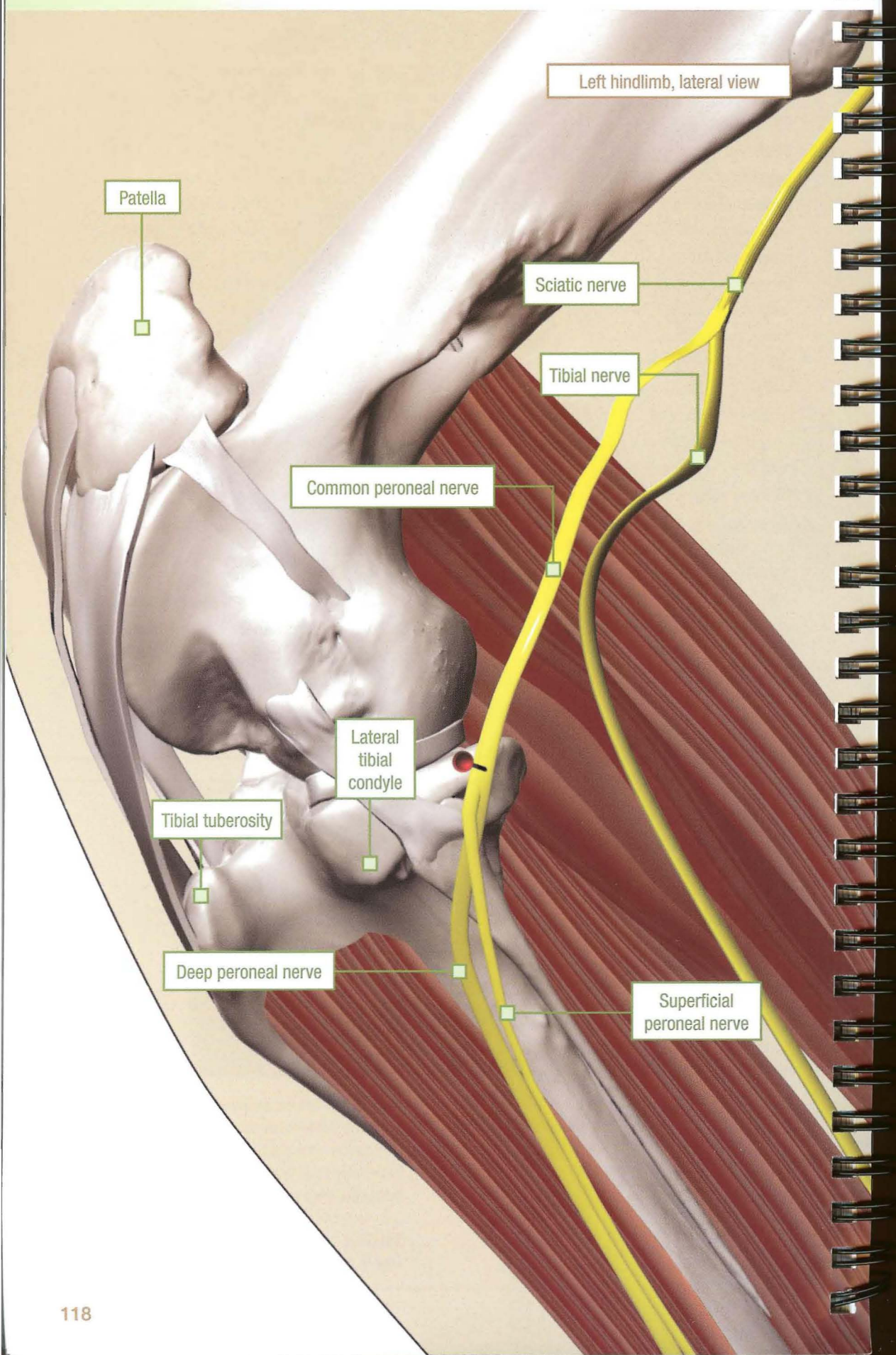


The **tibial nerve** is anesthetized about 4 inches (10 cm) above the point of the hock on the medial aspect of the limb, where it lies on the caudal surface of the deep digital flexor muscle, cranial to the calcaneal (Achilles) tendon. *Arrow* indicates needle placement. *Note: Needle is in the right hindlimb.*

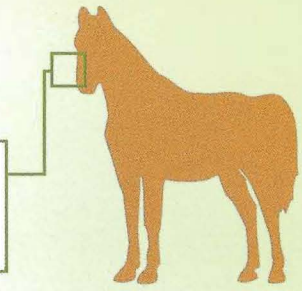


The site at which the **peroneal nerves** are usually anesthetized is on the lateral aspect of the limb about 4 inches (10 cm) above the point of the hock in the groove formed by the lateral and long digital extensor muscles. To anesthetize the **deep peroneal nerve**, insert a 1.5- to 2-inch (3.8- to 5-cm), 20- to 22-gauge needle into the groove and direct it slightly caudally until it contacts the caudal edge of the tibia. *Note: Needle is in the left hindlimb.*

COMMON PERONEAL NERVE



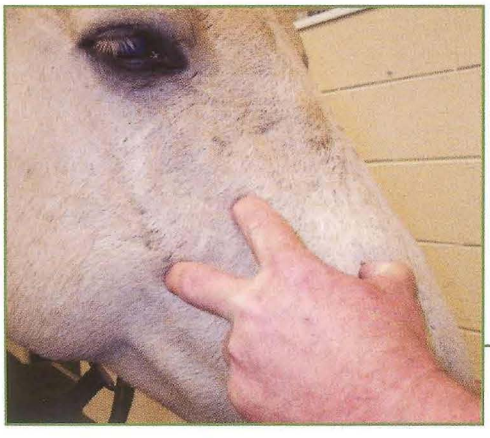
Needle: 1.5 in. (3.8 cm), 20 to 22 ga
Volume: 5 to 10 mL



The **infraorbital nerve** can be anesthetized within the infraorbital canal or where the nerve emerges from the infraorbital foramen. When anesthetized at the infraorbital foramen, the desensitized area includes the skin of the lip, nostril, and face up to the level of the foramen on that side of the head. Additional structures that are desensitized by injecting local anesthetic solution within the infraorbital canal include the ipsilateral nasal cavity, premaxillary incisors, canine tooth, premolars, probably the molars, and associated alveoli and gingiva.

To locate the infraorbital foramen, place a thumb in the nasomaxillary incisure and the middle finger on the rostral end of the facial crest. Locate the foramen with the index finger halfway between and 0.5 to 1 inch (1.3 to 2.5 cm) caudal to an imaginary line between these points. The bony ridge of the foramen can be palpated by pushing the ventral edge of the levator nasolabialis muscle dorsally. To anesthetize the infraorbital nerve within the infraorbital canal, insert a 1.5-inch (3.8-cm), 20- to 22-gauge needle through the skin about 1 inch (2.5 cm) rostral to the foramen after elevating the levator nasolabialis muscle. Insert the shaft of the needle about 1 inch (2.5 cm) into the canal and deposit 5 to 10 mL of local anesthetic solution.

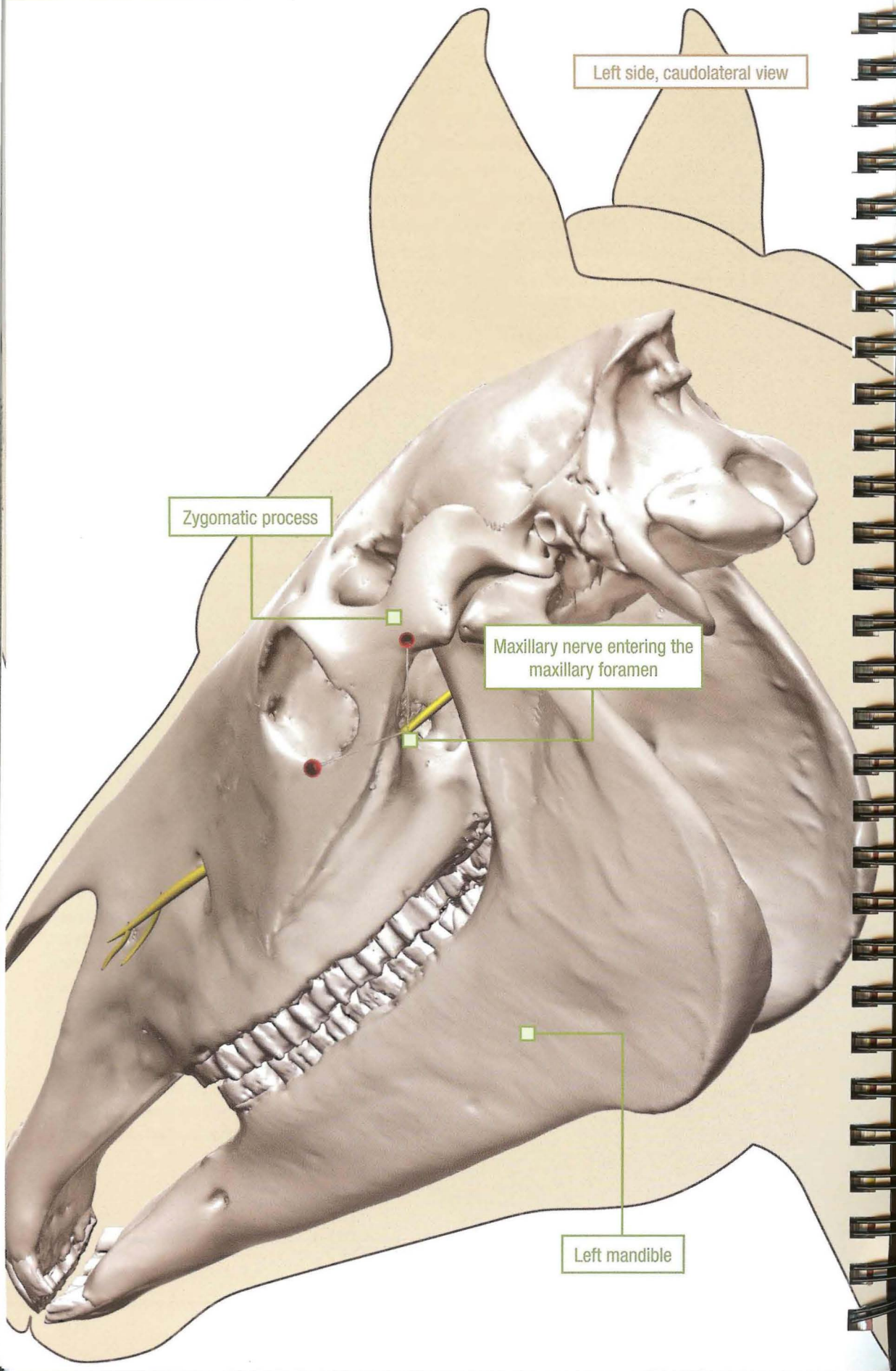
The infraorbital nerve block is useful for performing surgery of the nose or incisors, and both infraorbital nerves are sometimes anesthetized within the infraorbital canal as part of a diagnostic procedure to determine the cause of head shaking. Because the block is not tolerated well by the horse, adequate restraint and great care should be taken during its administration.



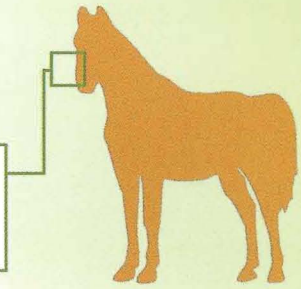
To locate the infraorbital foramen, place a thumb in the nasomaxillary incisure and the middle finger on the rostral end of the facial crest. Locate the foramen with the index finger halfway between and 0.5 to 1 inch (1.3 to 2.5 cm) caudal to an imaginary line between these points. *Note: The right side of the face is palpated.*

To anesthetize the **infraorbital nerve** within the infraorbital canal, insert a 1.5-inch (3.8-cm), 20- to 22-gauge needle through the skin about 1 inch (2.5 cm) rostral to the infraorbital foramen after elevating the levator nasolabialis muscle. *Note: Needle is in the right side of the face.*

MAXILLARY NERVE



Needle: 3.5 to 5 in. (9 to 12.7 cm), 20 to 22 ga, spinal
Volume: 15 to 20 mL

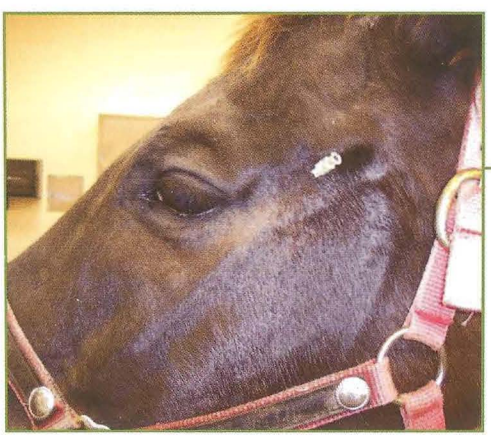


The paranasal sinuses, nasal cavity, and maxillary and premaxillary teeth and associated alveoli and gingiva can be desensitized by anesthetizing the ipsilateral **maxillary nerve**. The nerve is anesthetized in the pterygopalatine fossa at the maxillary foramen, where the nerve enters the infraorbital canal to become the infraorbital nerve. Two methods have been described to anesthetize the maxillary nerve; they are equivalent in accuracy.[27]

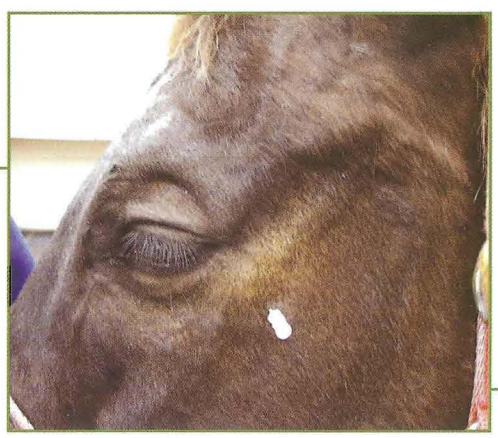
To anesthetize the **maxillary nerve** at the maxillary foramen, insert the point of a 3.5- to 5-inch (9- to 12.7-cm), 20- to 22-gauge spinal needle just ventral to the ventral border of the zygomatic process. Direct the needle rostrally and ventrally, aiming toward the sixth cheek tooth on the contralateral side of the head, until the point of the needle strikes the bone of the pterygopalatine fossa. The horse may jerk its head if the needle contacts the nerve.

Another method of blocking the **maxillary nerve** at the maxillary foramen is to insert the point of a 3.5-inch (9-cm), 20- to 22-gauge spinal needle just ventral to the zygomatic process and dorsal to the transverse facial vessels at the level of the caudal third of the eye.[28] Insert the point of the needle at a 90° angle to the long axis of the head until the point of the needle strikes the bone of the pterygopalatine fossa just caudal to the maxillary tuberosity at a depth of about 2 to 2.5 inches (5 to 6.4 cm).

If blood flows from the needle, the needle has been positioned too far caudally or ventrally in the pterygopalatine fossa. Deposit 15 to 20 mL of local anesthetic solution next to the bone and as the needle is withdrawn slightly. Structures innervated by the maxillary nerve are desensitized within 10 to 15 minutes.

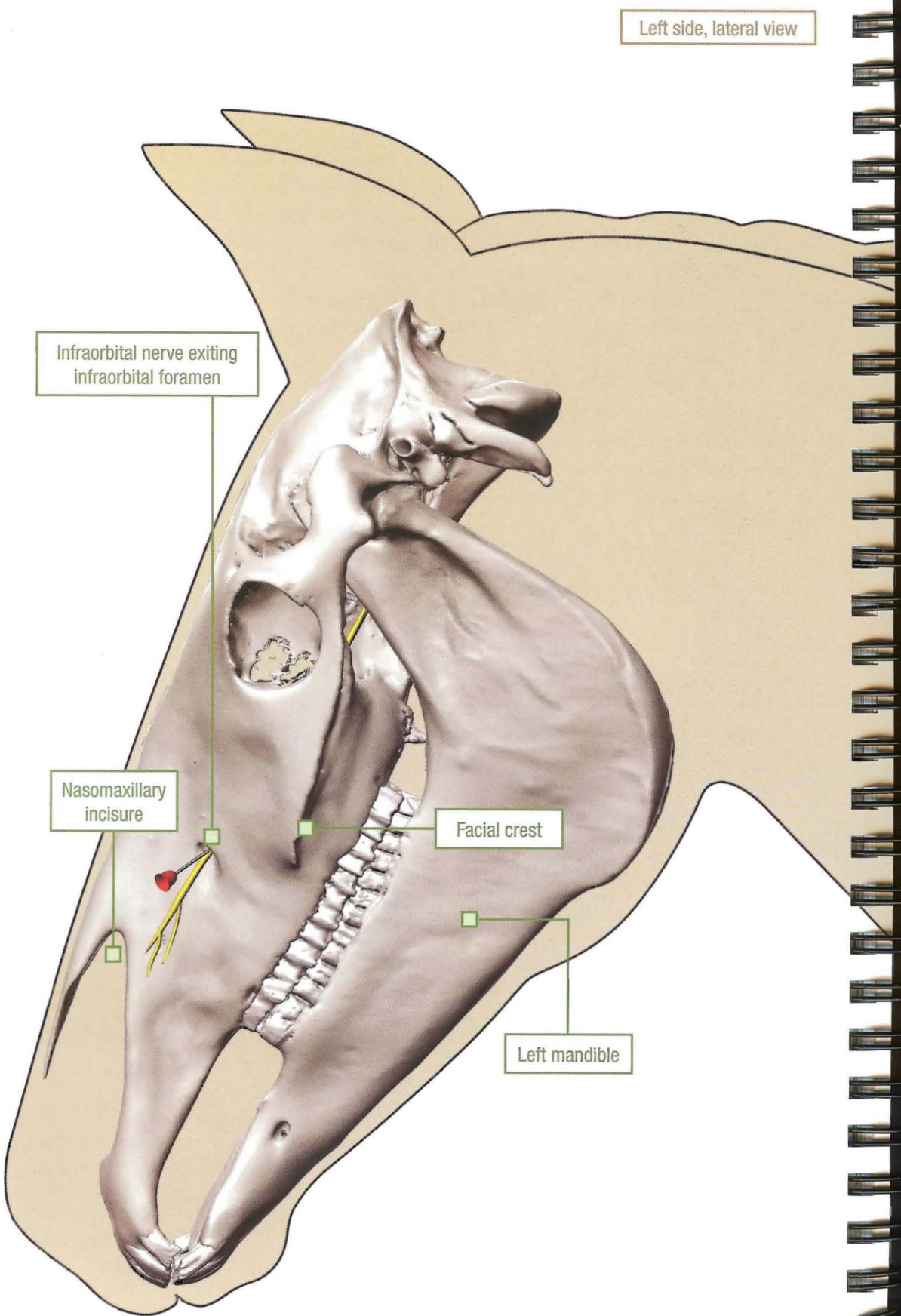


To anesthetize the **maxillary nerve** at the maxillary foramen, insert the point of a 3.5- to 5-inch (9- to 12.7-cm), 20- to 22-gauge spinal needle just ventral to the ventral border of the zygomatic process and direct the needle rostrally and ventrally, aiming toward the sixth cheek tooth on the contralateral side of the head until the point of the needle strikes the bone of the pterygopalatine fossa. *Note: Needle is in the left side of face.*

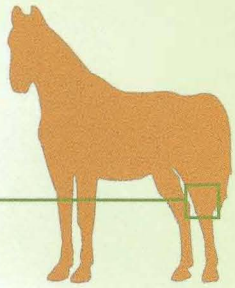


Another method of anesthetizing the **maxillary nerve** at the maxillary foramen is to insert a 3.5-inch (9-cm), 20- to 22-gauge spinal needle just ventral to the zygomatic process and dorsal to the transverse facial vessels at the level of the caudal third of the eye.[28] Insert the point of the needle at a 90° angle to the long axis of the head until the point of the needle strikes the bone of the pterygopalatine fossa just caudal to the maxillary tuberosity at a depth of about 2 to 2.5 inches (5 to 6.4 cm). *Note: Needle is in the left side of face.*

INFRAORBITAL NERVE

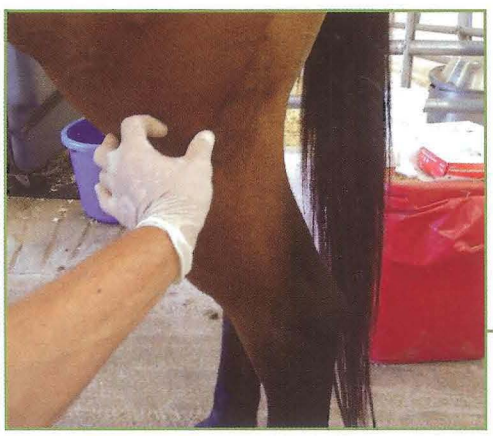


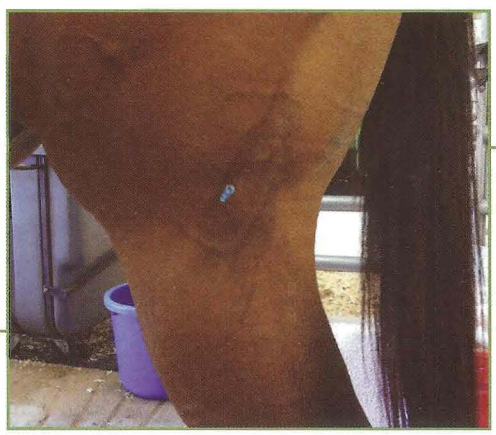
Needle: 5/8 in. (1.6 cm), 25 ga
Volume: 10 mL



Blocking the **common peroneal nerve** before it branches into the superficial and deep branches is more likely to cause the horse to knuckle in the fetlock than if the deep and superficial peroneal nerves are blocked individually. Because loss of skin sensation is variable with a peroneal nerve block, toe dragging can be a valuable aid in determining efficacy of the block. To avoid injury to the dorsum of the fetlock after this block, the block should be performed with the horse on soft footing, and the distal portion of the limb should be bandaged to protect the fetlock before the horse is trotted. Horses are most likely to knuckle in the fetlock at the beginning and end of a trot-up.

The **common peroneal nerve** is blocked where it emerges from beneath the biceps femoris muscle. The site for injection in the left pelvic limb can be found by placing the middle finger of the left hand on the tibial crest and the index finger of that hand on the lateral tibial condyle. The thumb of the left hand is placed at a point caudal to the index finger that is equal in distance between the index finger and the middle finger, on a line drawn mentally between the tibial tuberosity and the lateral tibial condyle that extends caudally. The site for injection of the right pelvic limb can be found by using the right hand in the same manner. The nerve can occasionally be palpated in its subfascial location beneath the thumb. To anesthetize the common peroneal nerve, a 5/8-inch (1.6-cm), 25-gauge needle is inserted to its hub, and approximately 10 mL of local anesthetic solution is deposited at this site and as the needle is withdrawn.

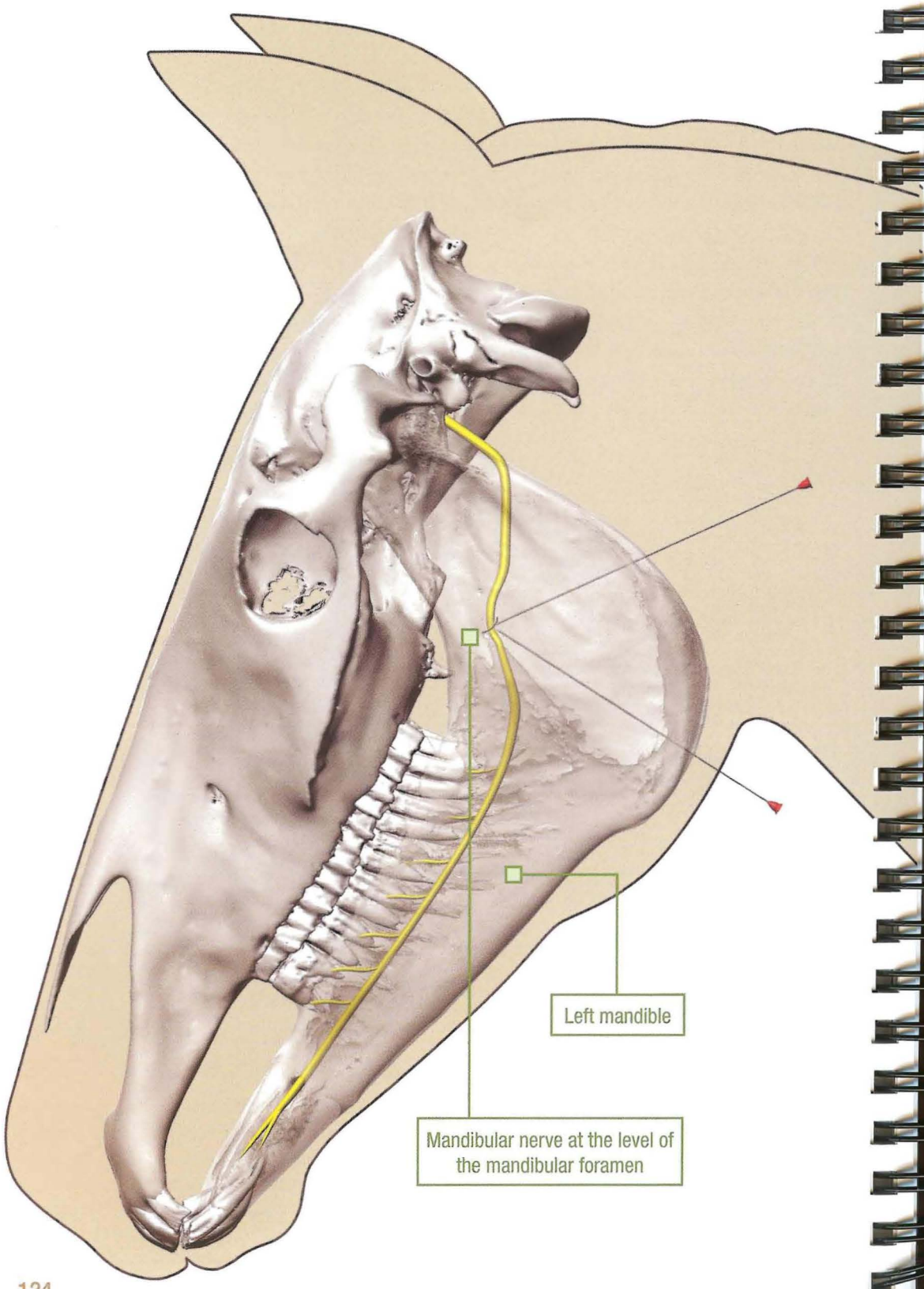




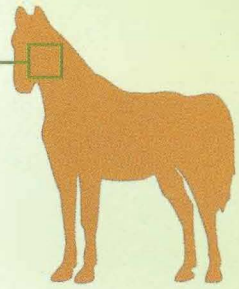
The site for anesthesia of the **left common peroneal nerve** can be found by using the left hand to palpate the tibial crest with the **middle finger** and the lateral tibial condyle with the **index finger**, placing the **thumb** an equal distance from the index finger. The nerve can often be palpated in its subfascial location under the thumb. A 5/8-inch (1.6-cm), 25-gauge needle is inserted to its hub, and 10 mL of local anesthetic solution is deposited at this site and as the needle is withdrawn. The site for injection of the right peroneal nerve can be found by using the right hand to identify landmarks. *Note: Needle is in the left hindlimb.*

When the **common peroneal nerve** is anesthetized, the horse may occasionally knuckle on its fetlock. To prevent injury to the dorsum of the fetlock, the distal portion of the limb should be bandaged and the horse's gait should be re-evaluated while it is trotted over soft ground. *Note: Bandage is on the left hindlimb.*

MANDIBULAR NERVE



Needle: 3.5 or 6 in. (9 or 15 cm), 20 to 22 ga, spinal
Volume: 15 to 20 mL

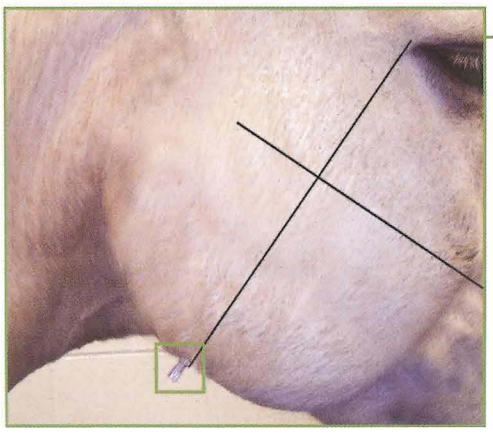


To desensitize one side of the mandible and all of its dental structures, the ipsilateral **mandibular nerve** can be anesthetized at the mandibular foramen where it enters the mandibular canal to become the mandibular alveolar nerve. The mandibular foramen is situated on the medial aspect of the vertical ramus of the mandible, at the junction of an imaginary line that extends along and caudal to the palpable buccal edge of the maxillary dental arcade and a second imaginary line drawn perpendicular to the first line from the lateral canthus of the eye.

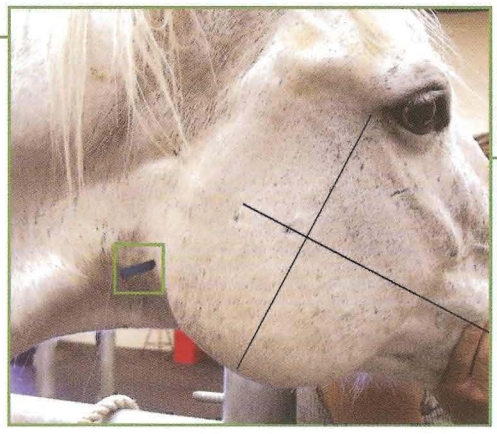
To anesthetize the mandibular nerve, insert the point of a 6-inch (15-cm), 20- to 22-gauge spinal needle at the medial aspect of the ventral border of the horizontal part of the ramus of the mandible, slightly rostral to the angle of the mandible. Advance the point of the needle vertically for 4 to 6 inches (10 to 15 cm) along the medial surface of the ramus until it reaches the junction of the previously described imaginary lines. Deposition of 15 to 20 mL of local anesthetic solution at this site desensitizes structures innervated by the mandibular nerve within 15 to 30 minutes.[27]

Another method of advancing the spinal needle to the mandibular foramen is to insert the point of the needle at the angle formed by the vertical and horizontal rami of the mandible. When this site for insertion of the needle is selected, a 3.5-inch (9-cm) spinal needle can be used. Advance the point of the needle about 3.5 inches (9 cm) rostrally and dorsally, as close as possible to the medial surface of the ramus, to the junction of the previously described imaginary lines.[28]

A horse should be muzzled for several hours after anesthetizing the mandibular nerve because the lingual nerve can be inadvertently anesthetized when the mandibular nerve is anesthetized. This causes the horse to lose tongue sensation, which can result in severe damage to the tongue if the horse is allowed to eat.

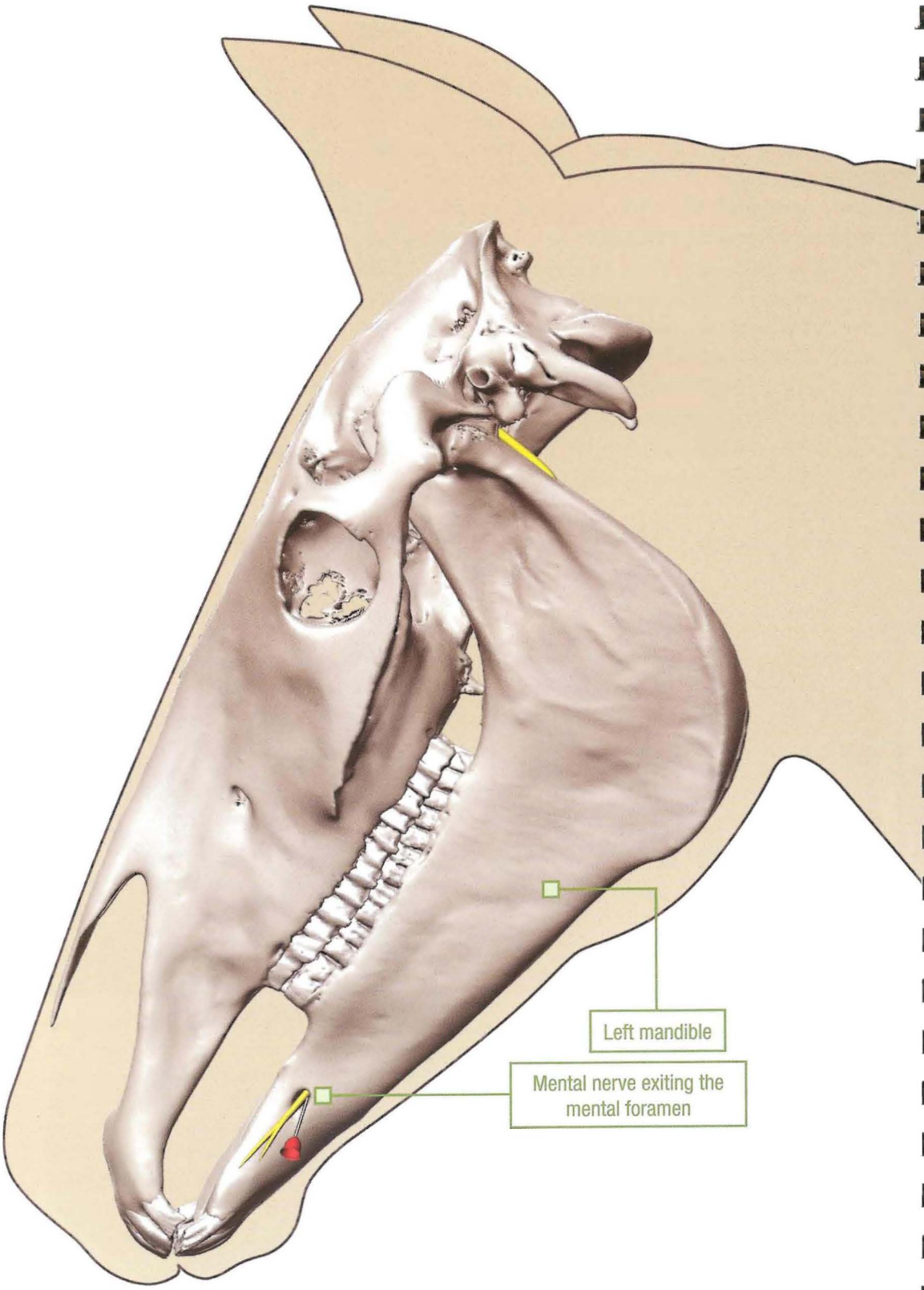


To anesthetize the **mandibular nerve**, insert the point of a 6-inch (15-cm) spinal needle at the medial aspect of the ventral border of the horizontal part of the ramus of the mandible, slightly rostral to the angle of the mandible. Advance the point of the needle vertically for 4 to 6 inches (10 to 15 cm) along the medial surface of the ramus until it reaches the junction of an imaginary line drawn across the edge of the maxillary dental arcade and another line drawn perpendicular to the first from the lateral canthus of the eye (*green box*). *Note: Needle is in the right side.*

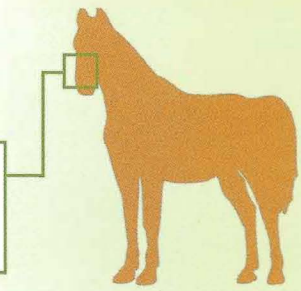


When the site for insertion of the needle for a **mandibular nerve block** is at the angle formed by the vertical and horizontal rami of the mandible, a 3.5-inch (9-cm) spinal needle can be used. Advance the point of the needle about 3.5 inches (9 cm) rostrally and dorsally, as close as possible to the medial surface of the ramus, to the junction of the previously described imaginary lines (*green box*).[27] *Note: Needle is in the right side of the head.*

MENTAL NERVE



Needle: 1.5 in. (3.8 cm), 20 to 22 ga
Volume: 5 to 10 mL



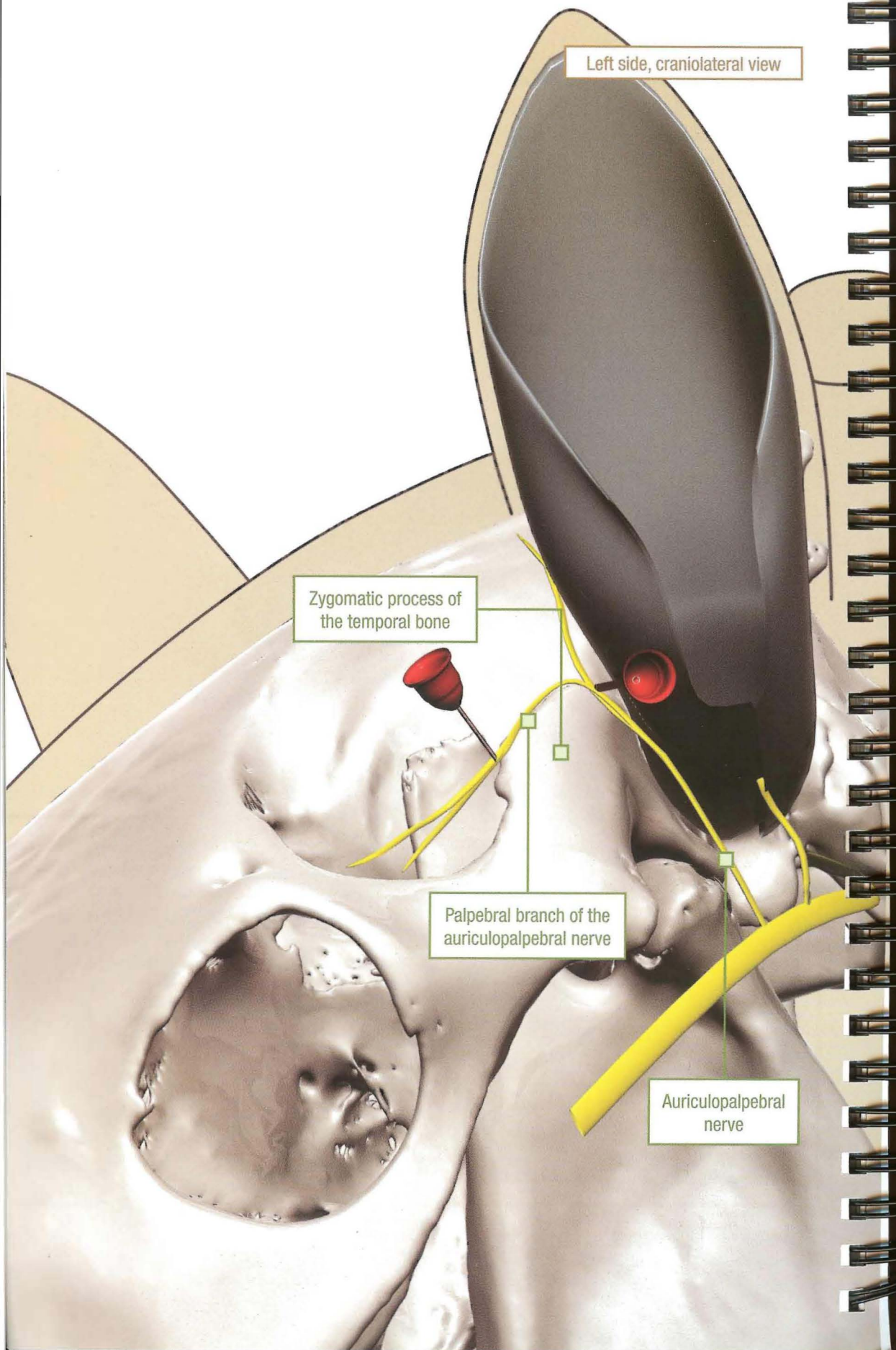
After passing through the mandibular canal, the **mandibular alveolar nerve** emerges at the mental foramen, where it is termed the **mental nerve**. Anesthetizing the mental nerve where it emerges from the mental foramen desensitizes the skin of the ipsilateral lip and chin. The mandibular canine, incisor, and cheek teeth and associated alveoli and gingiva are innervated by nerves that arise from the mandibular alveolar nerve within the mandibular canal; therefore, to desensitize these structures, the mandibular alveolar nerve must be anesthetized within the mandibular canal. Anesthetizing the mandibular alveolar nerve at the mental foramen or within the rostral end of the mandibular canal is referred to as a *mental nerve block*.

The mental foramen is situated below the commissure of the lips on the lateral aspect of the horizontal portion of the ramus of the mandible in the interalveolar space. The bony ridge of the foramen can be palpated by elevating the tendon of the depressor labii inferioris muscle with a finger. To anesthetize the **mandibular alveolar nerve** within the mandibular canal, insert a 1.5-inch (3.8-cm), 20- to 22-gauge needle through the skin about 1 inch (2.5 cm) rostral to the mental foramen after pushing the tendon of the depressor labii inferioris muscle dorsally. After inserting the needle into the mandibular canal as far as possible, inject 5 to 10 mL of anesthetic solution.

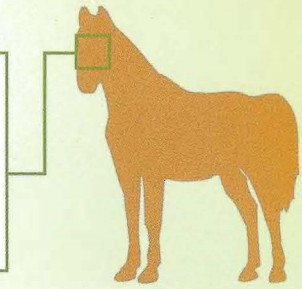
To anesthetize the **mandibular alveolar nerve** within the mandibular canal, insert a 1.5-inch (3.8-cm), 20- to 22-gauge needle through the skin about 1 inch (2.5 cm) rostral to the mental foramen after pushing the tendon of the depressor labii inferioris muscle dorsally. The mental foramen lies ventral to the lateral commissure of the lips. *Note: Needle is in the right side of the head.*

EYE AND SURROUNDING TISSUES

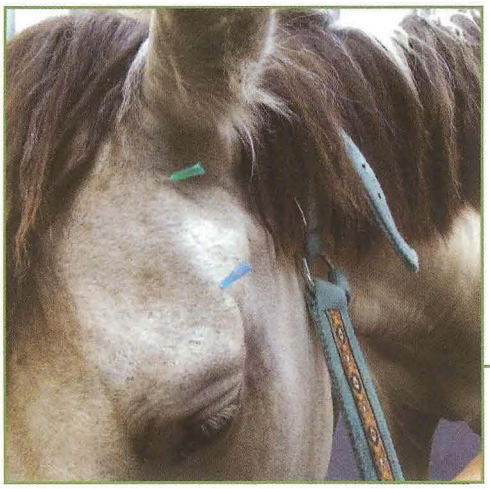
AURICULOPALPEBRAL AND PALPEBRAL NERVES



Needles: Auriculopalpebral nerve—1 in. (2.5 cm), 23 ga
Palpebral nerve—⅝ in. (1.6 cm), 25 ga
Volume: Auriculopalpebral nerve—5 mL
Palpebral nerve—1 to 2 mL



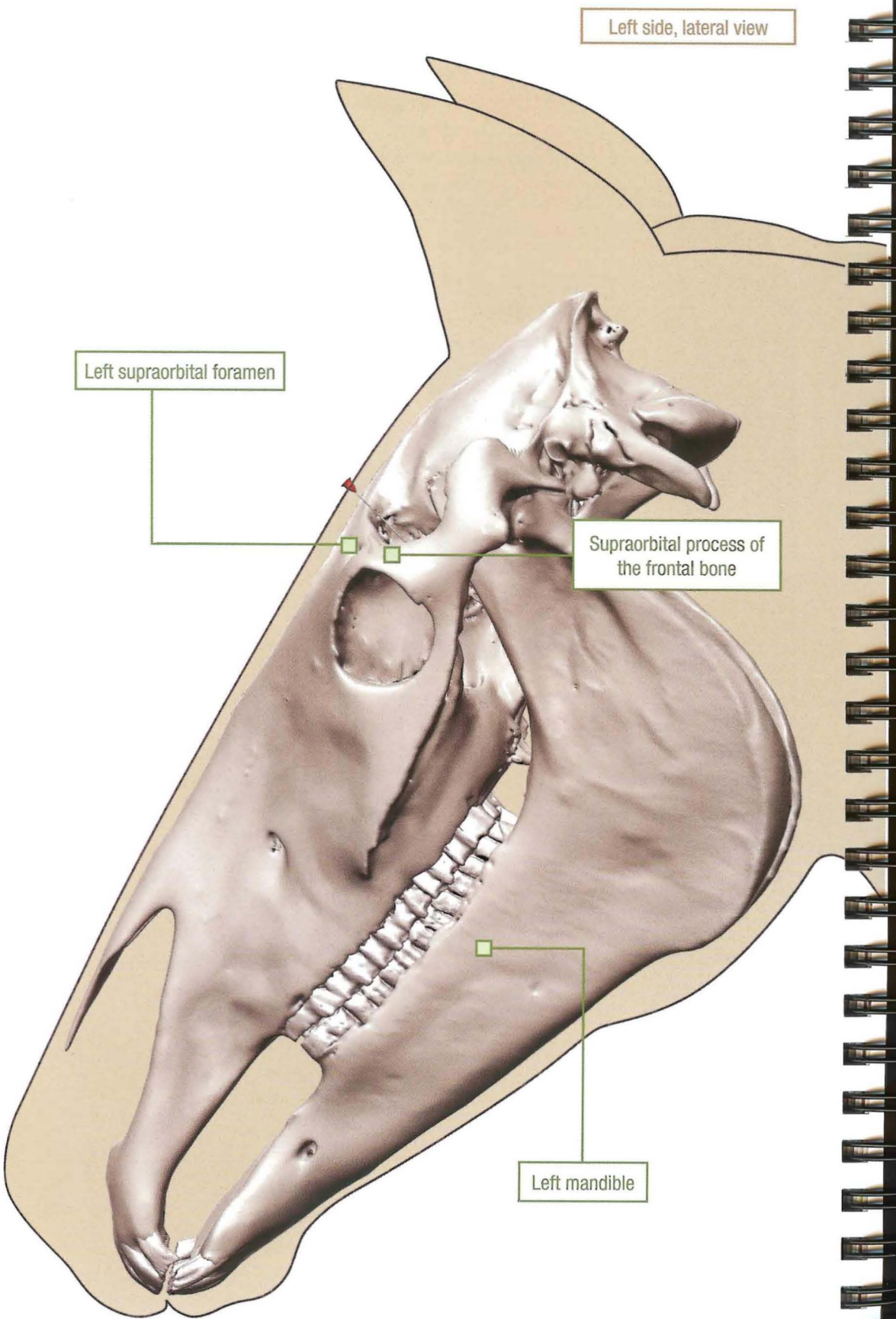
To paralyze the upper eyelid to facilitate examination or surgery of the eye, either the auriculopalpebral or palpebral nerve can be blocked.[29] The **auriculopalpebral nerve** can be anesthetized with 5 mL of local anesthetic solution administered at a depth of 0.8 inch (2 cm) in a depression palpated where the dorsal border of the zygomatic process of the temporal bone meets a line drawn along the caudal boarder of the ramus of the mandible. Alternatively, 1 to 2 mL of local anesthetic solution is injected subcutaneously over the **palpebral branch** of the nerve where it can be palpated as it crosses the dorsal aspect of the zygomatic arch halfway between the lateral canthus of the eye and the base of the ear.



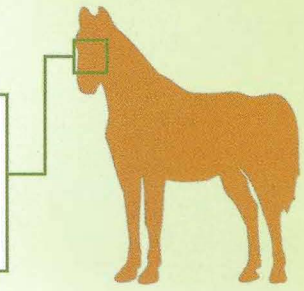
The **auriculopalpebral nerve** can be anesthetized in a depression palpated where the dorsal border of the zygomatic process of the temporal bone meets a line drawn along the caudal boarder of the ramus of the mandible. Alternatively, the **palpebral branch of the nerve** can be anesthetized as it crosses the dorsal aspect of the zygomatic arch, midway between the lateral canthus of the eye and the base of the ear. *Note: Needles are in the left side of the head.*

EYE AND SURROUNDING TISSUES

RETROBULBAR BLOCK

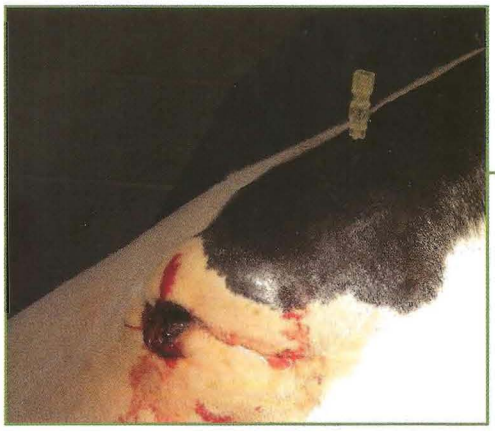


Needle: 2.5 or 3.5 in. (6.4 cm or 9 cm), 20 or 22 ga, spinal
Volume: 10 to 12 mL or 32 mL



The **retrobulbar block** is used for surgical procedures of the globe, such as intraocular and corneal surgery, and for enucleation when this surgery is performed with the horse standing. Several methods have been described for performing the retrobulbar block in the horse which blocks the optic nerve and all other nerves within the periorbita. The simplest method was described by Gilger and Davidson.[30] After surgical preparation of the orbital fossa, a 2.5- or 3.5-inch (6.4- or 9-cm), 22-gauge spinal needle is positioned perpendicular to the skin surface about 0.25 inch (0.6 cm) behind the bony dorsal orbital rim (supraorbital process of the frontal bone). The needle is directed ventrally until the eye has a slight dorsal movement, indicating that the needle has penetrated the retrobulbar cone and its tip is in the retrobulbar space. Local anesthetic solution (10 to 12 mL) is injected to cause exopthalmus, which indicates accurate placement of local anesthetic solution within the periorbital sheath. Onset of anesthesia is 5 to 10 minutes. Duration of anesthesia using lidocaine is 1 to 2 hours. The eyelids must also be desensitized to remove the eye.

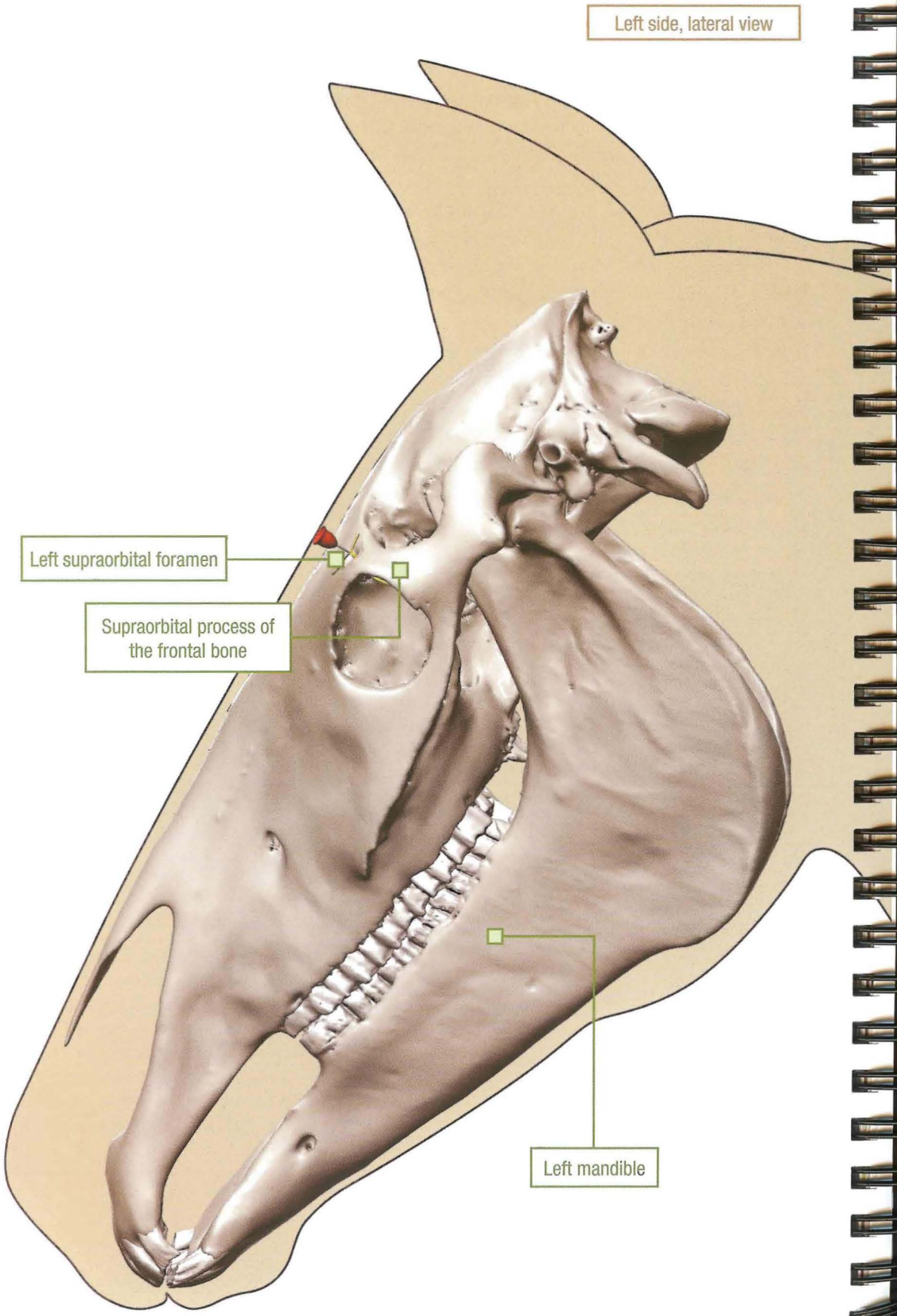
Another technique, the **four-point retrobulbar block** described by Pollock et al,[31] is to insert a bent 3.5-inch (9-cm), 20-gauge spinal needle through the eyelids in four sites around the rim of the orbit (the 12-o'clock, 3-o'clock, 6-o'clock, and 9-o'clock positions). The needle is advanced between the globe and the orbit toward the retrobulbar area. The tip of the needle penetrates the conjunctival fornix and a total of 8 mL of local anesthetic solution is deposited at each site, 4 mL at depth of insertion and 4 mL as the needle is withdrawn.



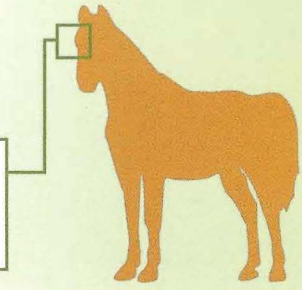
For the **retrobulbar block**, a 2.5- or 3.5-inch (6.4- or 9-cm), 22-gauge spinal needle is positioned perpendicular to the skin surface about 0.25 inch (0.6 cm) behind the bony dorsal orbital rim (supraorbital process of the frontal bone). The needle is directed ventrally until the eye has a slight dorsal movement, indicating that the needle has penetrated the retrobulbar cone and its tip is in the retrobulbar space. *Note: Needle is in the left supraorbital fossa.*

EYE AND SURROUNDING TISSUES

SUPRAORBITAL (FRONTAL), LACRIMAL, INFRATROCHLEAR, AND ZYGOMATICOFACIAL NERVES



Needle: 5/8 in. (1.6 cm), 25 ga
Volume: 1 to 2 mL or 2 to 3 mL at each site



For surgery of the adnexa of the eye, the skin and subcutaneous tissues of the eye can be desensitized by performing a subcutaneous ring block. Sensory innervation to the eyelids and tissue immediately surrounding the eye can also be blocked at specific sites. The **supraorbital (frontal) nerve block** desensitizes the medial two-thirds of the upper eyelid.[32] This block can be performed by injecting 1 to 2 mL of local anesthetic solution subcutaneously over or into the supraorbital foramen using a 5/8-inch (1.6-cm), 25-gauge needle. The right supraorbital foramen can be found by placing the thumb of the left hand at the medial canthus of the eye and the middle finger of that hand at the lateral canthus. The index finger falls on the foramen, which can easily be palpated. The left supraorbital foramen can be found by using the right hand and reversing positions of the thumb and middle finger to allow the index finger to fall on the foramen. Another method of locating the supraorbital foramen is to grasp the supraorbital process between the thumb and middle finger. These digits are moved medially until the bone begins to widen. The index finger then falls on or close to the foramen when it is pressed against skin. Local anesthetic solution deposited at this site also anesthetizes a portion of the palpebral nerve to decrease movement of the upper eyelid.

The lateral one-third of the upper eyelid is anesthetized with the **lacrimal nerve block.**[32] A 5/8-inch (1.6-cm), 25-gauge needle is inserted along the dorsal rim of the orbit just medial to the lateral canthus. The needle is directed just beneath the dorsal rim, and 2 to 3 mL of local anesthetic solution is injected.

The **infratrochlear nerve block** desensitizes the medial canthus of the eye[32] and is partly responsible for innervation of the third eyelid. The site of injection is found by palpating the rim of the orbit dorsal to the medial canthus to locate a notch in the orbital rim just above the medial canthus. Local anesthetic solution (2 to 3 mL) is deposited at this site.

The lateral three-quarters of the lower eyelid is anesthetized with the **zygomaticofacial nerve block.**[33] To perform this block, the needle is inserted at the ventral aspect of the orbital rim just medial to the lateral canthus, and 2 mL of local anesthetic solution is injected.

EYE AND SURROUNDING TISSUES

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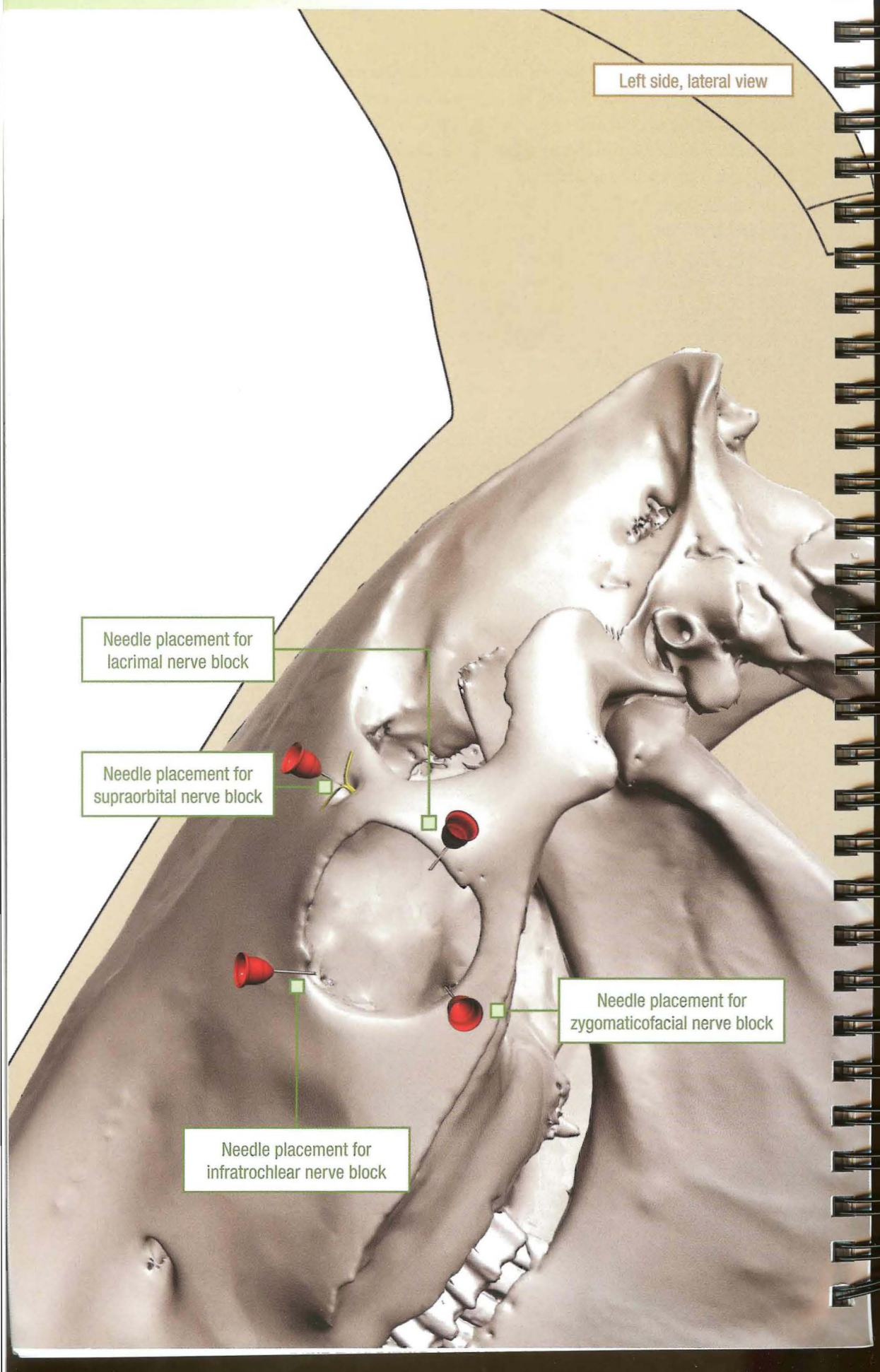
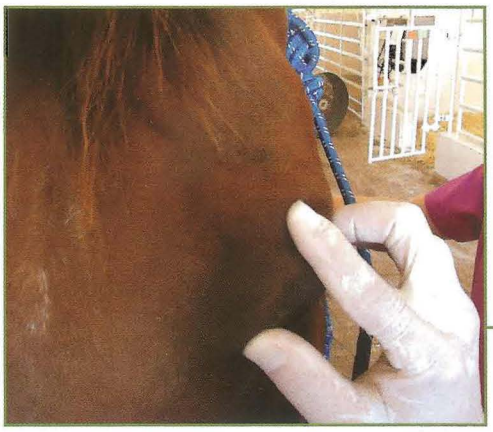
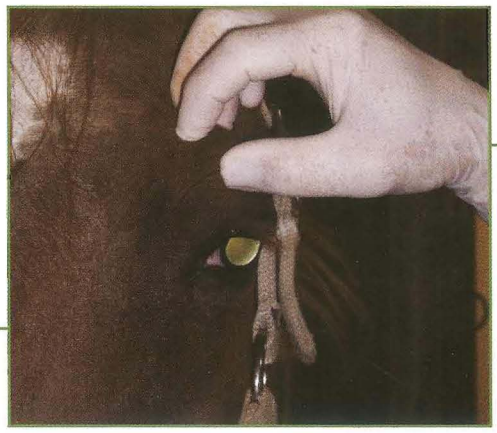


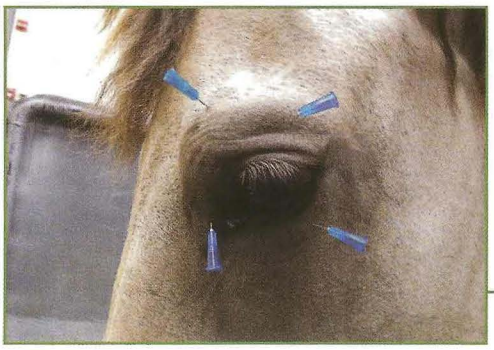
Needle: 5/8 in. (1.6 cm), 25 ga
Volume: 1 to 2 mL or 2 to 3 mL at each site



The **left supraorbital (frontal) nerve** can be anesthetized at the supraorbital foramen, which can be found by placing the thumb of the right hand at the medial canthus of the eye and the middle finger of that hand at the lateral canthus. The index finger falls on the foramen, which can easily be palpated. The right supraorbital foramen can be found by using the left hand and reversing positions of the thumb and middle finger to allow the index finger to fall on the foramen. *Note: The left side of the face is being palpated.*



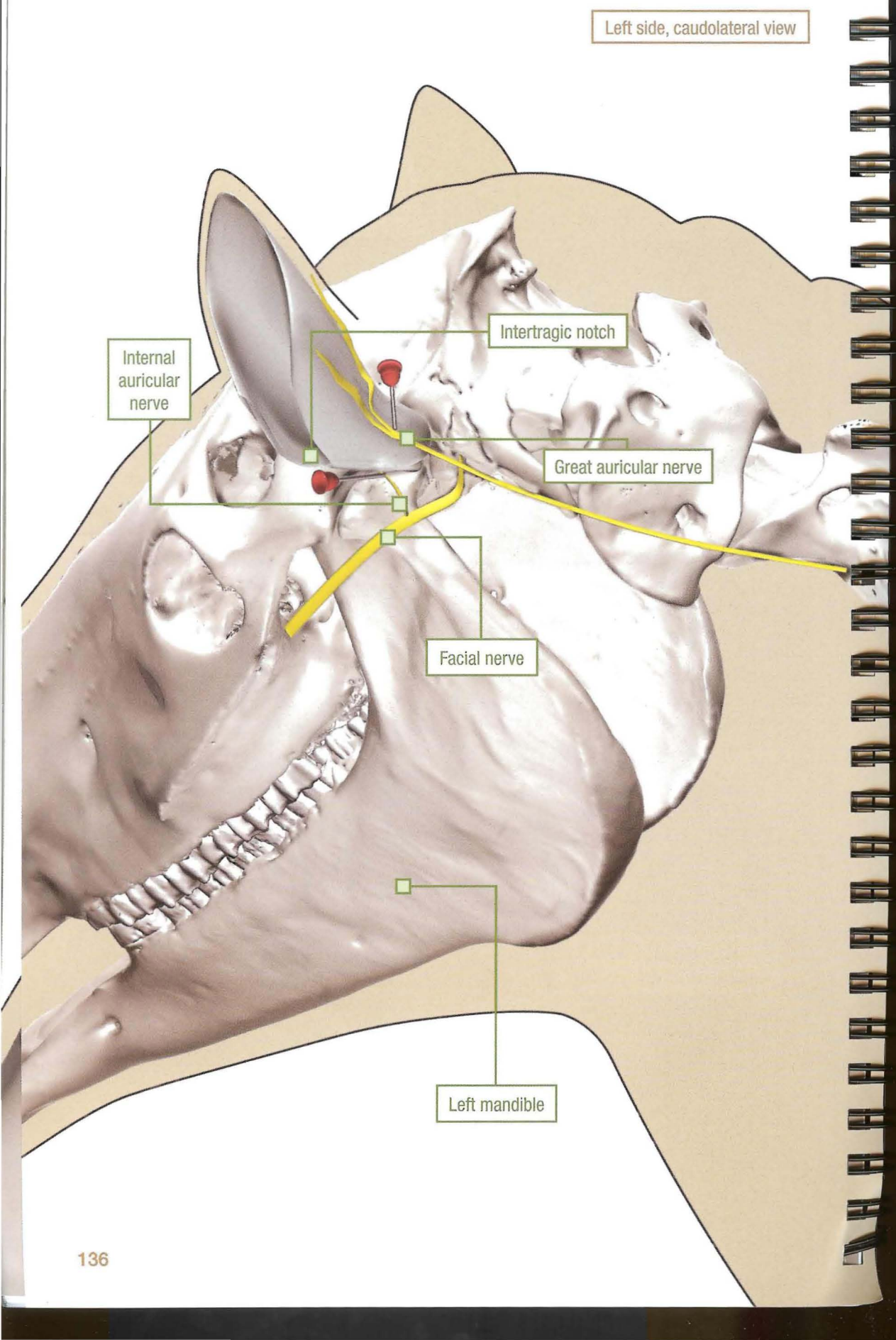
The supraorbital foramen can also be located by grasping the supraorbital process between the thumb and middle finger. These digits are moved medially until the bone begins to widen. The index finger then falls on or close to the foramen when it is pressed against skin. *Note: The left side of the face is being palpated.*



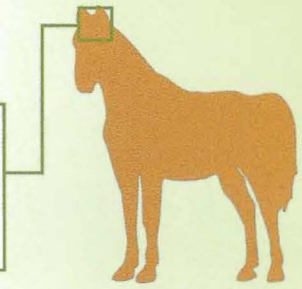
To desensitize the eyelids, 2 to 3 mL of local anesthetic solution is deposited at the orbital rim at four sites (see text). *Note: Needles are in the left side of the face.*

EAR AND SURROUNDING TISSUES

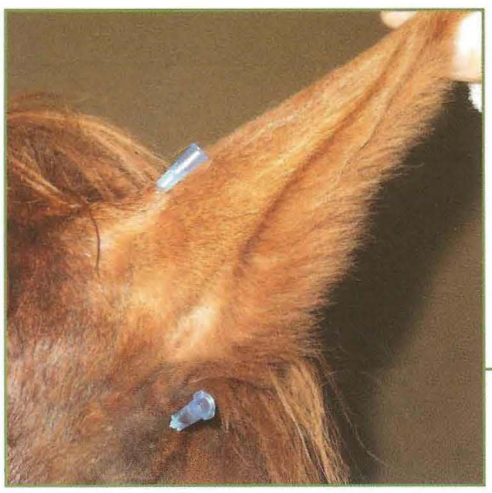
GREAT AURICULAR AND INTERNAL AURICULAR NERVES



Needles: Great auricular nerve—1 in. (2.5 cm), 22 ga
Internal auricular nerve—⅝ in. (1.6 cm), 25 ga
Volume: 2 to 3 mL at each site



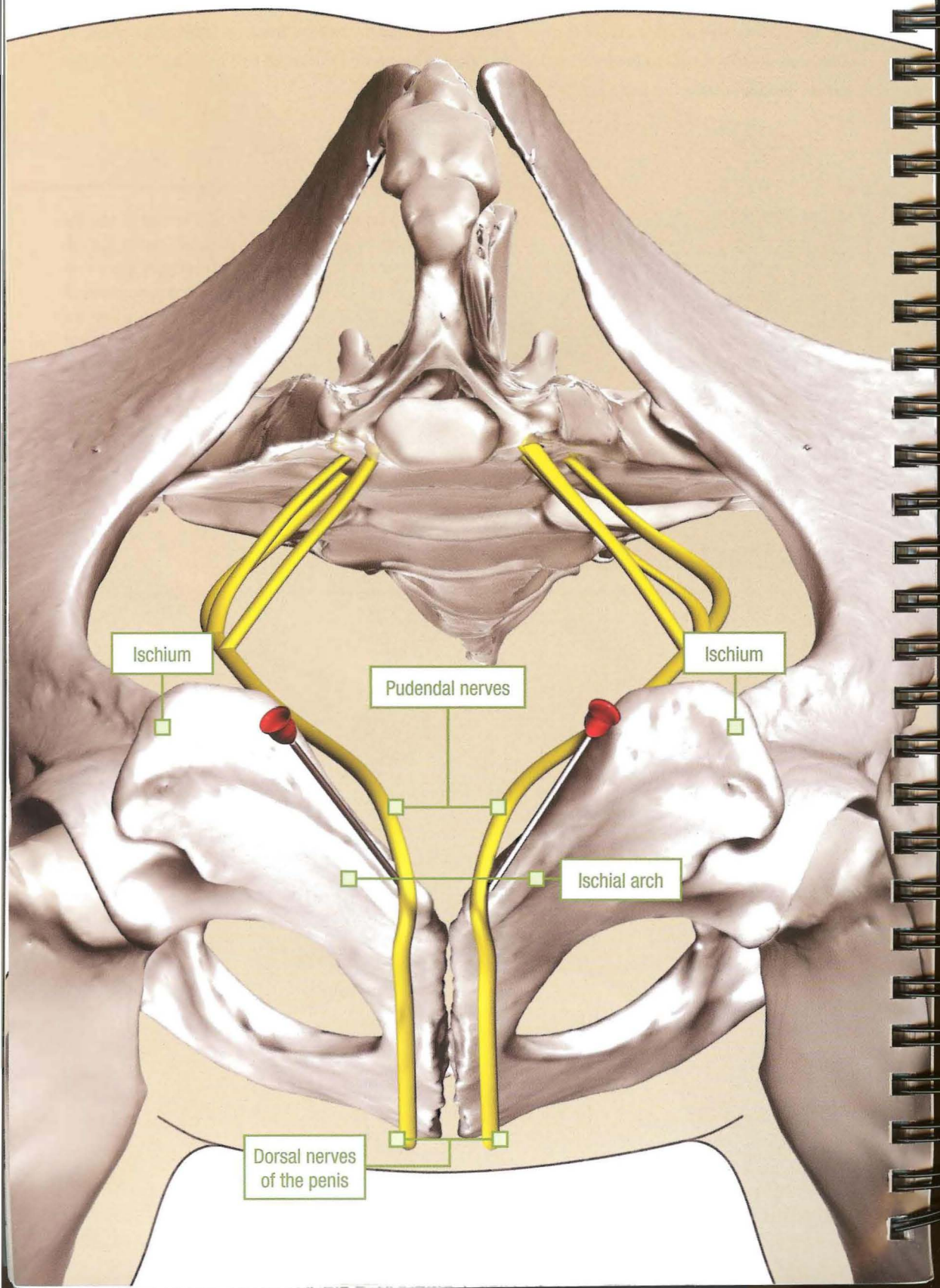
The pinna of the ear can be anesthetized for surgical procedures performed with the horse standing by blocking both the great auricular and internal auricular nerves at the base of the pinna.[33] The **great auricular nerve** can be palpated near the base of the pinna on the pinna's convex (caudal) surface. The nerve runs in the direction of the longitudinal axis of the pinna. The **internal auricular nerve** lies on the convex surface in a crease formed where the auricular cartilage folds on itself. This crease is palpated slightly rostral to the intertragic notch. Local anesthetic solution (2 to 3 mL) injected into the crease should anesthetize this nerve.



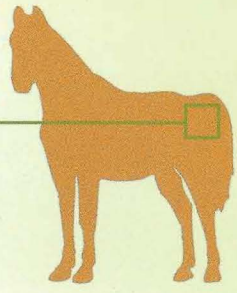
The **great auricular nerve** can be anesthetized near the base of the ear on the pinna's convex (caudal) surface. The nerve runs in the direction of the longitudinal axis of the pinna. The **internal auricular nerve** is anesthetized on the convex surface in a crease formed where the auricular cartilage folds on itself. This crease is palpated slightly rostral to the intertragic notch. *Note: The needles are in the left ear.*

PUDENDAL NERVE

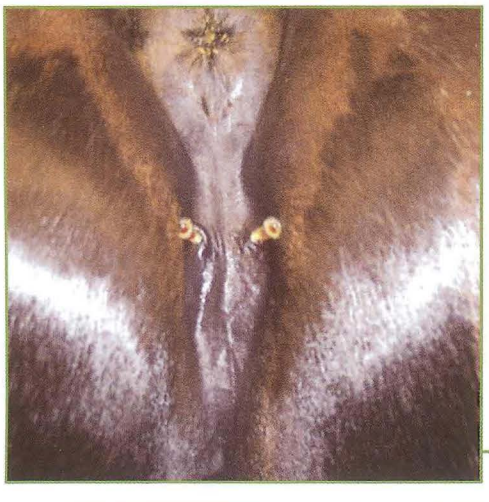
Pelvis, caudal view



Needle: 1.5 in. (3.8 cm), 20 to 22 ga
Volume: 5 mL at each site

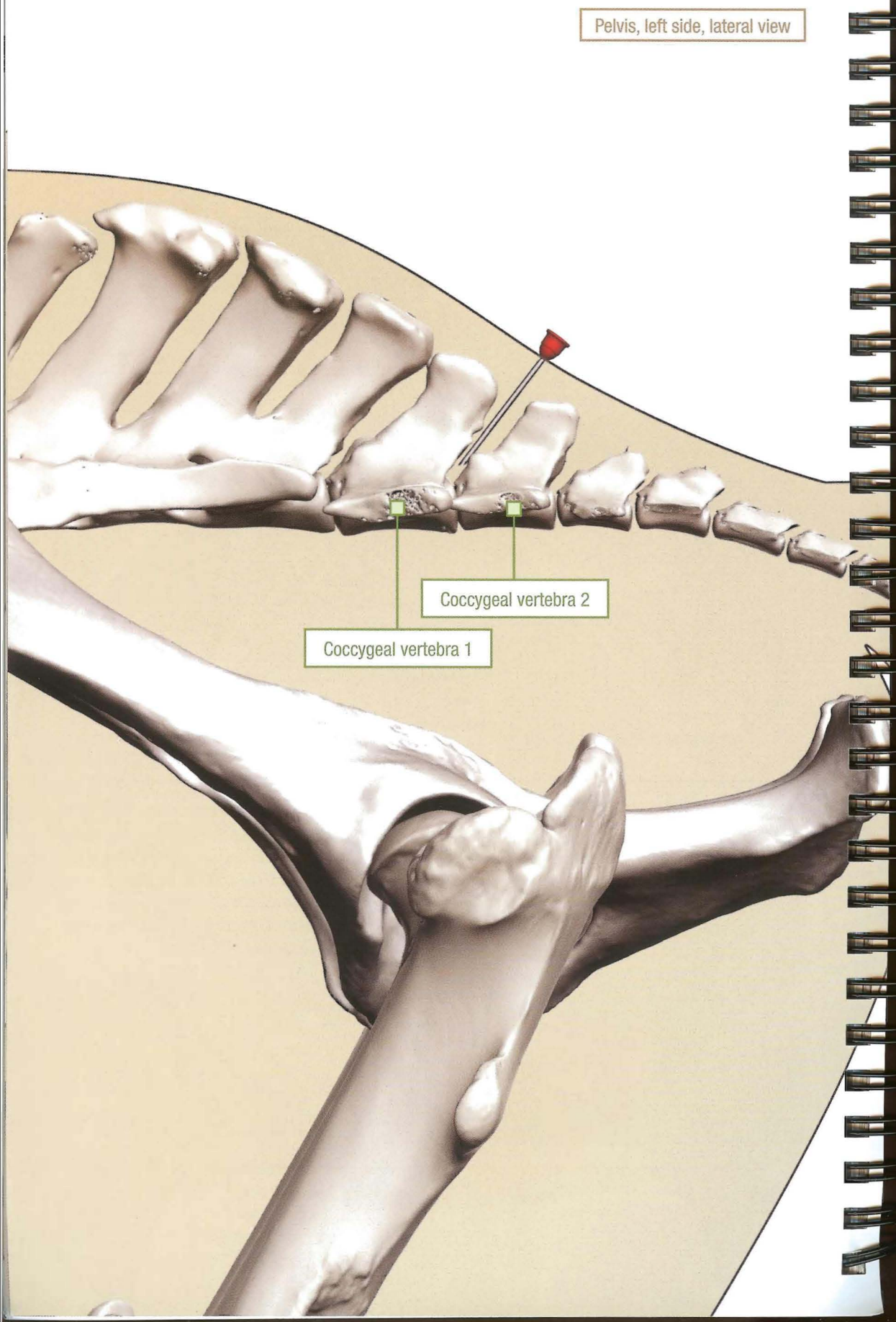


The penis and internal lamina of the prepuce can be desensitized and extruded from the preputial cavity by anesthetizing the **pudendal nerves** at the level of the ischial arch.[34] To anesthetize the pudendal nerves where they course around the ischium, insert a 1.5-inch (3.8-cm), 20- to 22-gauge needle on both the right and left sides of the penis about 1 inch (2.5 cm) dorsal to the ischium. Angle the point of the needle ventrally, aiming for a point on the ischium slightly lateral to the midline, until the point of the needle contacts the ischium. Penetration of the penis by the needle, which may occur, seems to cause no complications. Contact between the tip of the needle and the ischium is usually necessary for the block to be effective. The penis usually protrudes within 5 minutes after 5 mL of local anesthetic solution is deposited at each site. Using a short-acting local anesthetic solution (e.g., lidocaine) rather than mepivacaine avoids prolonged penile and preputial protrusion. Mepivacaine should be used if prolonged penile and preputial desensitization is required.

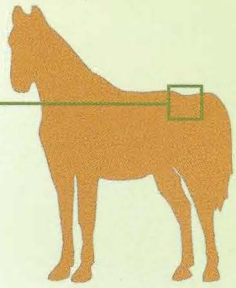


To anesthetize the **pudendal nerves** where they course around the ischium, insert a 1.5-inch (3.8-cm), 20- to 22-gauge needle on both the right and left sides of the penis about 1 inch (2.5 cm) dorsal to the ischium. Angle the point of the needle ventrally, aiming for a point on the ischium slightly lateral to the midline. The tip of the needle should contact the ischium.

EPIDURAL ANESTHESIA

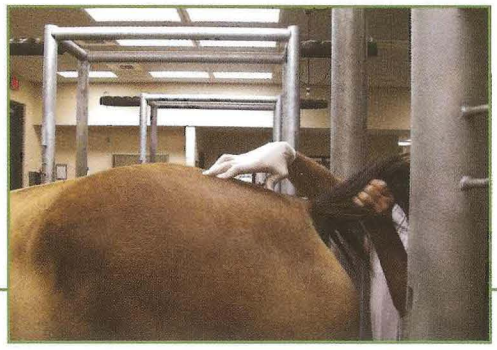


Needle: 1.5 in. (3.8 cm) or longer, 18 to 20 ga
Volume: 3 to 4 mL (per 1,000-lb [455-kg] horse)



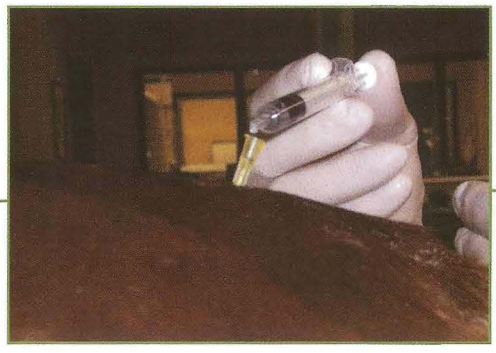
Local anesthetic solution is administered to the **epidural space** (between the periosteum and dura mater of the vertebral canal) for the purpose of allowing surgery of the rectum, vagina, perineum, and tail to be performed with the horse standing. It can also be administered to relieve tenesmus and to facilitate obstetrical procedures. A 1.5-inch (3.8-cm) needle is of sufficient length to reach the epidural space of most horses, even draft horses, with normal body condition. The site of injection is between the first and second coccygeal vertebrae (the first coccygeal vertebra is usually fused to the sacrum). This site can easily be found by moving the tail up and down while using the thumb to palpate for

The site of injection for **caudal epidural anesthesia** is between the first and second coccygeal vertebrae (the first coccygeal vertebra is usually fused to the sacrum). The easiest method of locating the space between the first and second coccygeal vertebrae is to palpate the drop between the spinous processes of these vertebrae, which is present because the spinous process of the first coccygeal vertebra is substantially higher than that of the second coccygeal vertebra.



The site for **caudal epidural anesthesia** can easily be found by moving the tail up and down while using the thumb to palpate for movement at the most cranial moveable intervertebral space.

A 1.5-inch (3.8-cm) needle is of sufficient length to reach the **epidural space** of most horses, even draft horses. The needle's hub is filled with local anesthetic solution. The needle is advanced perpendicular to the skin surface until the tip of the needle encounters the floor of the neural canal. The needle should be positioned on the midline and advanced exactly on the median plane, perpendicular to the contour of the croup. When the tip of the needle enters the epidural space, the drop of solution in the hub should be sucked into the epidural space.

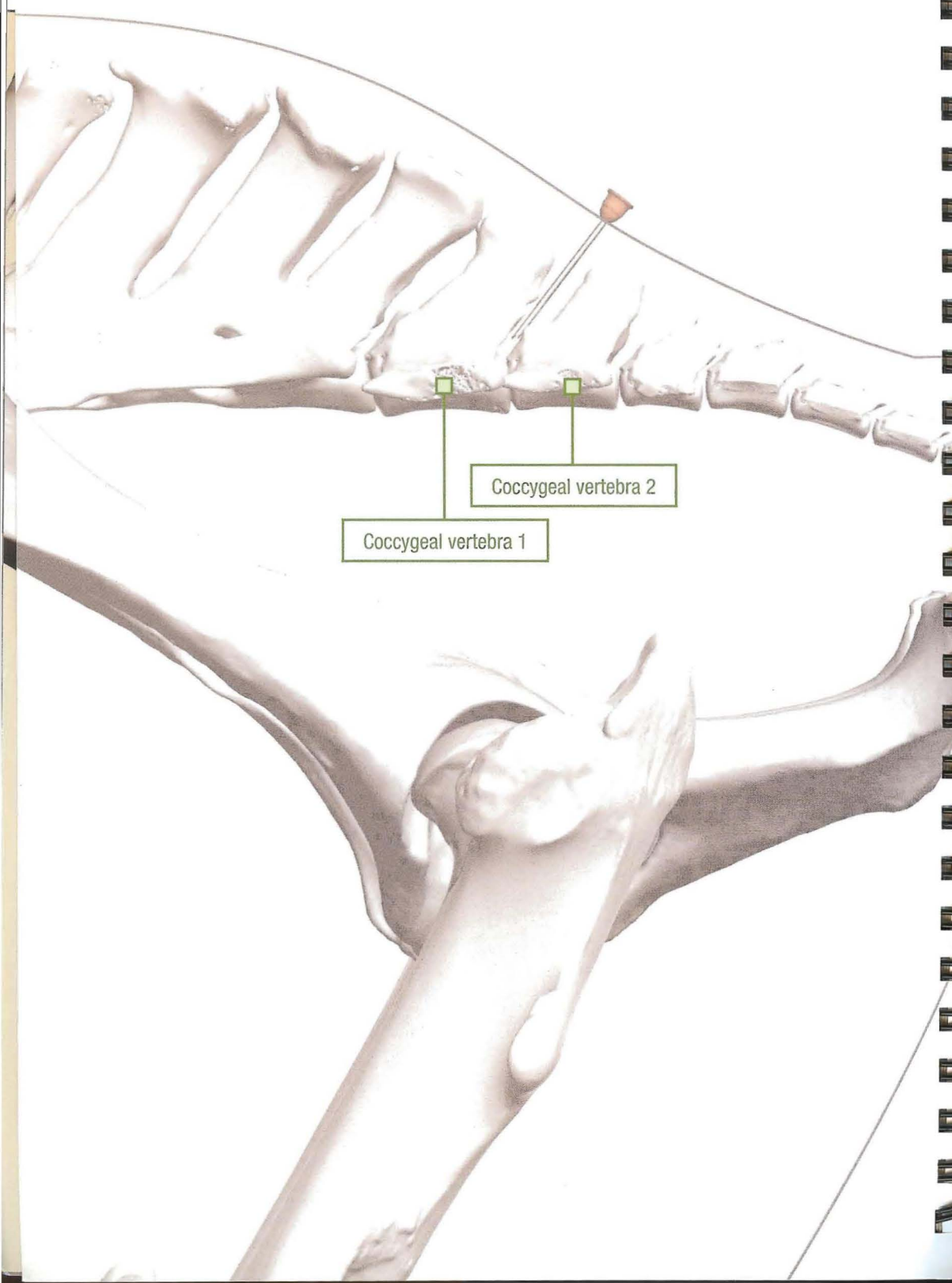


Drops of local anesthetic solution dropped over the needle hub are sucked into the **epidural space** when the needle is properly positioned.

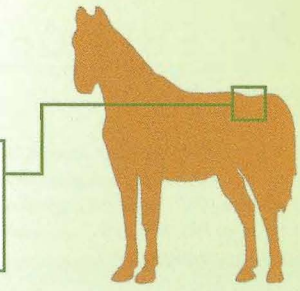
EPIDURAL ANESTHESIA

CONTINUED

Pelvis, left side, lateral view



Needle: 1.5 in. (3.8 cm) or longer, 18 to 20 ga
Volume: 3 to 4 mL (per 1,000-lb [455-kg] horse)



movement at the most cranial moveable intervertebral space. The easiest method of locating the space between the first and second coccygeal vertebrae is to palpate the drop between the spinous processes of these vertebrae, which is present because spinous process of the first coccygeal vertebra is substantially higher than that of the second coccygeal vertebra.

After preparing the site of aseptic centesis, the tip of the needle is placed subcutaneously (a bleb of local anesthesia administered through a ⅝-inch [1.6-cm] 25-gauge needle is optional). The needle's hub is filled with local anesthetic solution, and the needle is advanced perpendicular to the skin surface until the tip of the needle encounters the floor of the neural canal. The needle should be positioned on the midline and advanced exactly on the median plane, perpendicular to the contour of the croup.[35] When the tip of the needle enters the epidural space, a drop of local anesthetic solution in the hub should be sucked into the epidural space. If the needle is accurately positioned, local anesthetic solution can be administered without resistance. Analgesia is usually complete in about 15 to 20 minutes. Relaxation of the anal sphincter is an indication that the block was performed accurately. The epidural block should be re-administered with caution because paralysis of the pelvic limbs can occur from an overdose if the first block was accurate but its effects were slow in onset.

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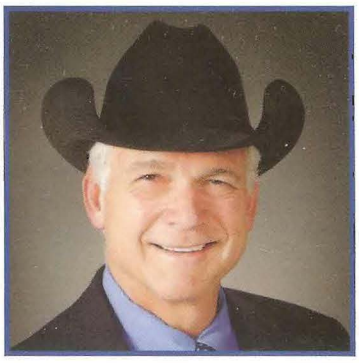
ABOUT THE CONTRIBUTORS

AUTHORS



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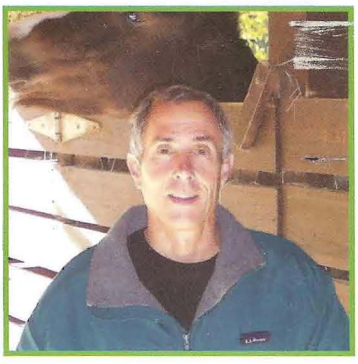

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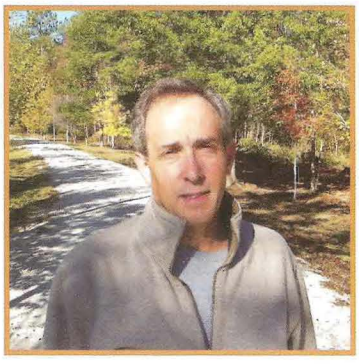

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